EXPERIMENTAL PSYCHOLOGY

AND ITS BEARING UPON CULTURE

Experimental Psychology

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BY

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PREFACE

THE aim of the present volume is to give an untechnical account of certain groups of experiments in psychology and to show something of their significance. As to the particular experiments that are of most interest and importance in this field, of course opinions would differ. Every one who works in psychology soon finds himself attracted in special directions, and on the whole it is perhaps well for a writer to respect this element of personal affinity. But in preparing the book, I have aimed to present, as best I could within somewhat narrow limits, the character and value of the laboratory psychology, especially as bearing upon our moral and philosophical interests. In this way the book is planned to occupy a different field from that already so well covered by the excellent works of Titchener, Sanford, and Scripture.

Considerable attention has thus been given to the interpretation of the experimental results, — to their more immediate scientific meaning, as well as to what they suggest for life and for speculation. But first and foremost the purpose has been to get the experiments themselves clearly before the reader, so that the main features of the research work might

be seen concretely. Many of the experiments thus described are already familiar to students of psychology, but a number appear here for the first time.

It would be difficult, if not impossible, to tell in detail of my obligation to others. I cannot forbear to mention, however, the Council and members of the Philosophical Union of the University of California, who some years ago invited me to speak to them upon the character and import of psychological experiments, and to whose interest and encouragement the present volume largely owes its existence. I am also particularly grateful to my friend, Professor Bakewell, who has kindly read the book in proof, and has given me throughout most helpful advice. In preparing the chapters dealing with the psychology of Æsthetics I have received great benefit from the criticism of my friend, Mr. Frederic C. Torrey, and I am indebted to my colleague, Dr. Montague, for similar aid in regard to certain problems of Space. For the photographs required in many of the illustrations I must thank Mr. Brand, the former Assistant in the Laboratory, and Mr. Dunlap, the present Assistant. There is a more general indebtedness to my honored teacher, Professor Wundt of Leipzig, who introduced me to the experimental work. But I owe most of all to my teacher and friend, Professor Howison, to whom I should have been glad to dedicate affectionately this book were I not so fully conscious of its shortcomings.

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CHAPTER I

HISTORICAL INTRODUCTION

ONLY within a few years has it been generally known that experiments on the mind were being attempted. Doubtless the whole subject has still for some an air of novelty and perhaps almost of faddishness, as if it had sprung into life but yesterday and would pass away to-morrow. But the fact is, that like so many things that suddenly catch the public eye, the days of its growth have been long and quiet, and the suddenness is not of its appearance but only of noising its fame abroad. For just as Darwinism was germinating in the days of Heraclitus, so we can now discover the premonitions of what is often called the "New Psychology" at least as early as Aristotle. He performed experiments in psychology, and ever since his time traces of such work can be found. The modern turn, then, is not in discovering the possibility of psychological experiments, but in becoming distinctly conscious of their value, — in utilizing them, therefore, to a greater extent and in developing something like a critical procedure in carrying them out.

The roots of the "New Psychology."

To understand the motives that have led to the laboratory work in psychology one must recall that for centuries the peculiar and solitary method of

Reasons for its growth.

getting at the facts of mind was supposed to be that of self-observation, or of introspection, as it is more frequently called. Whether we recognize the method by name or not, it certainly is one with which all are familiar. You can probably tell, for instance, whether the thought of territorial expansion beyond the seas meets your approval, or whether you view it with mingled consent and distrust, or perhaps with unmixed regret. This direct acquaintance with the state of our minds which all of us to some extent possess, is the essence of introspection, and, as I have said, was for centuries the only recognized mode of collecting the data of psychology. The psychologist turned his mental gaze inward, and reported as best he could what he there observed. The objects of this science were supposed to be noted by some inner sense, in contrast with our eyes and ears, with which we observe external objects, the materials for the familiar natural sciences.

Difficulties of introspection.

Now it can be pretty clearly shown that self-observation must always be the fundamental method of psychology; it permits the initial step and furnishes us with all the really first-hand knowledge of the mental world that we possess. But for all that, one must not fail to recognize the historical fact that psychology, as long as it relied solely on this method, was at a striking disadvantage compared with the natural sciences generally. In the first place, the posture of introspection is cramped and unnatural. We are practical beings and, if we are healthy, life has trained us to be interested in things beyond ourselves. The habit of self-observation, if not a morbid

trait, as in Amiel or Marie Bashkirtseff, is at least artificial, and tends to throw the whole mental train off the track. Try, for instance, to be deeply interested in what some one is saying to you, and at the same time to scrutinize and report to yourself how it feels to be deeply interested. Many of our most important mental states positively refuse to be gazed at in this way; they elude our direct scrutiny, and the best we can do is — paradoxical as it sounds — to recall how they looked when we were not looking at them.[1] Compared with those sciences whose materials are absolutely indifferent to any amount of weighing and grinding and heating and examination, one can well understand how the progress of psychology was inevitably slow and, to some extent, disappointing. Moreover, there is something peculiarly private and incommunicable in every fact of mind. We cannot, as a mineralogist may, hand around our particular speci-

[1] This fugitive character of many of our mental states has often been pointed to in proof of the impossibility of introspection. The truth of course is, that only by means of introspection do we know that our mental processes are changeable and elusive. It is curious that when critics like Maudsley, at least in his earlier writings, make such short work of self-observation as a psychological method, they do not see that most of the facts they bring forth as evidence of its fundamental inadequacy are obtained only by this very self-observation. They trust their own introspection in its report that the mental life is always in flux, that attention to our mental processes alters their character, etc., and then argue that this discredits the whole procedure; whereas these very results show that the method, within certain limits, is the readiest and most reliable we have.

Such criticisms also invariably dwell on those mental processes (the emotions, for instance) that are most liable to interruption if we attend to them, and cannot well be repeated at will, and leave out of account the many processes, such as perceptions and judgments and certain memory-images, that can be repeated and observed with great security.

men of judgment or volition, and ask others to verify the results of our examination of it. The results of self-observation consequently seem to be personal and "subjective," and lacking in that universality which is the pride of chemistry and of physics. It was to be expected, then, that there would be a longing for some mode of investigation wider in its application and more fruitful than self-observation, and that in due time there would be an organized revolt in favor of "objective" methods, among which the experimental procedure was to have an important place.

Desire for "objective" methods.

Influence of British empiricism. Bacon to Hume.

The present-day experimental study of mind is but the latest development of that scientific movement of which Francis Bacon was chief spokesman. Bacon led to Hobbes, with whom there began the strong empirical movement in psychology in the seventeenth and eighteenth centuries, to which our present methods of investigating the mind owe so much. The English were the first to become interested in psychology for its own sake. On the continent it had always been a secondary matter, a mere appendage to metaphysics; whereas the English, in Locke and Berkeley and Hume, almost reversed the order and made metaphysics a subordinate chapter of psychology. At any rate, the facts of our everyday mental life at last came to their own, and in the writers just mentioned some of the chief problems of the experimental work began to be mapped out.

Berkeley's psychology of space.

Berkeley's remarkable "Essay toward a New Theory of Vision" shows a distinctly modern attitude toward psychology, which at that day it would indeed be diffi-

cult to parallel. He states the particular question, how we are able to discern by sight the size and distance and shape of objects; and after a masterly array of facts and arguments, comes to his well-known conclusion that none of these aspects of things is given us by vision alone and of itself, but only by vision in conjunction with our sense of touch. Not until we are able to translate our impressions of sight into terms of touch and muscular movement, does our vision come to mean for us anything spatial. If history had been as silent in regard to the life and time of Berkeley as it is about the personality of Shakespeare, not only his theory but also the manner in which he supports it might have given excellent grounds for some clever critic to claim that the good bishop had merely lent his name to the production of some shy disciple of Helmholtz or of Wundt. So far as I am aware, Berkeley gives the first instance of a problem of psychology being thus disentangled and honored with a special and purely psychological treatise.

Surgeons' experiments to test his view.

As if to furnish the experimental verification which Berkeley himself recognized was needed for his theory, there soon appeared the first of a series of contributions by various physicians in the "Philosophical Transactions of the Royal Society of London," giving the results of experiments on persons operated upon for congenital cataract. The most celebrated case was that reported by Cheselden in 1728, and this was followed by others from Home, Ware, Wardrop, and many besides. If Berkeley's theory were correct, then a person gaining his sight sud-

denly, as these patients for the most part did, ought not to be able to discern the shape or distance or direction of objects by sight alone, but only by sight working in combination with touch. A number of tests were accordingly made, the detailed discussion of which will come more appropriately in a later chapter. Here it is sufficient to say that the results have generally been considered as strongly in favor of Berkeley's theory; but this interpretation is, I think, open to question, and needs a careful review. The interesting fact in the present connection, however, is not whether the evidence he offered is adequate or inadequate, but that Berkeley and a large body of men recognized in this practical way that there were important psychological problems which were to be decided, not by the traditional introspective method, but by external and experimental means.

Place of the English associationists.

We may pass by the later English development in Hartley, James Mill, John Stuart Mill, and Spencer. It is of great importance for the history of psychology in general, but not for the growth of the experimental side. These men were system-makers, interested most of all in working out what seemed to them to be the one great explanatory principle in psychology, — the principle of association. It is well that there are such men, who feel that the subordinate questions of a subject are to be answered by learning the common secret of the whole. But experimental psychology is indebted perhaps more to those whose interests run to the opposite pole, — who feel that the search for the secret of the whole may be de-

ferred until we know more about the subordinate parts of that whole. Wisdom is doubtless justified of both kinds of children. But it is easy to see that when the English psychological activity turned more and more to buttressing up a system, the atmosphere there grew less stimulating for the other kind of work. Germany, on the other hand, was running exactly the opposite course. The Germans, after their long line of philosophers from Leibnitz to Hegel, were at last coming to the point which England and France had reached long before,—were losing faith in philosophy altogether, and were preparing to attack the problems of mind from the other side.

The Germans weary of metaphysics.

But in Germany, as in England, the interest in the experimental study of consciousness was not developed entirely from within the ranks of the psychologists themselves. Goethe, for instance, was among the early experimenters in psychology. He made an interesting study of the influence of color upon the emotions, by observing the landscape through glasses now of one color and now of another, and noting the contrasting moods induced by the different hues.[1] And some experiments which bear a much closer connection with the direct historical development came indeed from the astronomers, brought about, of course, not by any special interest in psychology, but by the practical needs of their observatory work.

Goethe's experiments with color.

Psychological experiments by astronomers.

According to the older method of determining the time when a star reached its meridian, the observer watched the passage of the star through the field of his telescope, and at the same time listened

[1] *Farbenlehre*, §§ 769, 784, 798.

to the beats of a clock near at hand. As the critical moment approached, he had now to perform the somewhat difficult task of noting at what instant in the series of pendulum beats the passage of the star across the meridian (marked by a hair-line in the field of the telescope) actually occurred. To do this accurately he must tell not merely at which beat of the clock this transit took place, but since the transit usually occurs somewhere between two beats, he must determine the more exact fraction of a beat which had elapsed when the star reached the meridian. This was the "eye and ear" method, now discarded, by many astronomers, for the chronograph with its electric recorders. The astronomer Bessel noticed as early as 1822 that when different persons observed the very same fact, there were discrepancies which could be accounted for only by the different make-up of the observers themselves. And experiments were accordingly instituted to determine what has since come to be known as "personal equation." All this was a psychological matter, and the experiments that gave some light on the question were psychological experiments, even though carried on from an interest primarily in quite a different field. Out of these has grown an important group of laboratory investigations in what is called reaction-time, of which more will be said in a later chapter.

Determination of "personal equation."

Influence of the physiologists.

But the work which had a more direct influence in developing systematic experimentation in psychology came from the physiologists, especially from those who were interested in the sense-organs. Any one who will turn the pages of the particular volumes of

Hermann's "Hand-book" that are devoted to the subject, will see how many experiments were early carried on to discover primarily the function of the sense-organs, but which in so doing laid bare much of the psychology of our sense-perception. Probably few besides professional students appreciate the fact that much of Helmholtz's labors lay on the psychological side of the border between physiology and psychology, and that he may be claimed for either science. His great works on "Physiological Optics" and on "Sensations of Tone" are stores of psychological material gathered in, for the most part, through Helmholtz's own genius for devising and carrying out experiments in this field. And there were many other pioneers in the same region. Vierordt, for example, more than half a century ago, made an experimental study of our sense of time — a field of investigation since then diligently worked in the modern laboratories. And almost with apologies, one ought to mention the phrenologists, Gall and Spurzheim. Unscientific as the whole spirit of these men was, their curious system undoubtedly did much to stimulate those later experiments regarding the connection between brain and consciousness, that led to the brilliant discoveries in the "localization" of mental function, with which the names of Broca, Goltz, Ferrier, and many others are connected.[1]

Helmholtz's psychological work.

Phrenology and modern brain localization.

[1] The more physiological aspects of psychology are considered at some length in the chapter on "The Connection of Mind and Body." There is an excellent sketch of the growth of this neural work by Dr. Henry Smith Williams in an article entitled "The Century's Progress in Experimental Psychology," in *Harper's Magazine* for September, 1899, Vol. 99, p. 512.

The immediate parentage of experimental psychology.

When we try to trace out, however, not so much the various distant sources, but the immediate parentage of experimental psychology, one must name first of all Ernst Heinrich Weber. With him there begins what we might call an unbroken experimental tradition.

E. H. Weber.

Up to Weber's time (his *floruit* is well along in the second and third quarters of the nineteenth century), and even with many who outlived him, psychological experiments were carried on sporadically and without much appreciation of their true significance. Weber, however, aroused an interest not only in his results, but even more in the experimental method by which his results were obtained. He made men recognize experimentation as a mode of procedure for psychology, — a recognition which since his time has gradually become clearer until now it is no longer open to doubt. So that the historical importance of Weber's experiments quite overshadows their intrinsic interest. But his contributions so enter into the after-life of the subject, and in telling of his successors one must so often refer to Weber's Law, that it will perhaps be well to go somewhat into detail at this point, even at the risk of seeming prolix.

Character of his experiments.

In these experiments the more immediate purpose was to determine the relative sensitiveness of different parts of the skin, probably with some appreciation of the value of such tests for the physician. In certain nervous diseases, for instance, the symptoms are in part a lowering or heightening of the sense of touch, and the character and extent of the disease are indicated by comparing the sensitiveness of the

patient with that of a normal person. Weber arrived at a table of this normal sensitiveness and its variations for different parts of the body, experimenting with compass points and with weights.

But more important, judged by the amount of discussion they set going, were his experiments on our power of *comparing* different weights on the skin. His tests here led him to discover an interesting bit of relativity. He placed a standard weight of 32 drachms on his hand and found that an addition of about 10 drachms made the weight sensibly heavier. But when he used, instead, a standard weight of 32 ounces (eight times heavier than the former standard) the same absolute addition of 10 drachms was no longer detected, but he must make the same *relative* addition, namely 10 ounces, before the weight was noticeably increased. Stated as a general proposition, applicable not only to weights and pressures, but to all our perceptions, this becomes the famous formula known as Weber's Law, that our power of detecting differences between sensations does not depend on the absolute amount of difference in the stimuli, but on its relative amount. And although some might believe that it did not require experiments to show so obvious a truth, yet later researches have demonstrated that it is by no means so obvious after all, and that there are considerable stretches of our mental life where, if the law does hold good, something at least interferes with its clear manifestation.

His law of discrimination.

One of the most important results of Weber's experiments, however, was their effect upon Fechner, a German scientist of philosophical bent. He

Fechner and the Psycho-physical Law.

entered with zeal upon the investigation of the problem which Weber's studies had raised, and for years his daily programme included an hour or more of careful and accumulated tests of the validity of Weber's Law, by an elaborate method (and for his day, somewhat elaborate apparatus) largely of Fechner's own devising. Finding that the results he obtained by his thousands of experiments in lifting weights were approximately what the law would require, he recast Weber's statement into a mathematical formula which, in spite of its impressive logarithmic appearance, is in all probability not so near the actual truth as is Weber's own simpler expression. Having satisfied the mathematical impulses within him, Fechner next fell to work to point out the philosophical consequences which his formula might imply. The result of his own and Weber's experiments seemed to him to indicate a peculiar interrelation of brain and mind — that the mind is, in some respects, more sluggish than the brain, and that as we increase the activity of the brain, the activity of the mind increases at a much slower pace. Or, to express his view more exactly and technicaliy, our sensations vary in intensity as the logarithm of the brain-action which corresponds to them.[1] Because

[1] With Fechner the law took the mathematical form: —

$$\gamma = k \log \frac{\beta}{b},$$

where γ represents the intensity of the sensation, β the amount of the stimulus, b the threshold intensity, and k a constant to be determined experimentally for each of the senses. See his *Elemente der Psychophysik*, 2d ed., Vol. II, p. 13.

It might be added that the essential point of Fechner's modification

Fechner believed that his modification of Weber's Law expressed a fundamental relation between the world of matter and the world of mind, his formula is known as the Psycho-physical Law, and experiments in this line, or even merely in verification of Weber's Law, are often grouped together under the term "psycho-physics."

But whatever we may think of Fechner's interpretation of his results, his robust faith in experiment and his feeling of the bearing of such work on the fascinating problem of mind and brain did much to accelerate the movement which Weber had inaugurated. With his work is directly connected that of Müller at Göttingen, whose correspondence with Fechner over their common interests has made an attractive little book. At Müller's laboratory one may still see Fechner's contrivances for his weight

G. E. Müller.

of Weber's Law is often attributed to Weber himself, even by careful writers. The statement of the law, that for the sensation to increase in arithmetical progression the stimulus must increase in geometrical progression, is in the spirit of Fechner rather than of Weber. Weber himself apparently never went into the question of the mathematical relation between stimulus and sensation, and merely expressed the fact that in making comparisons we note the *relative* differences of things, and not their *absolute* differences. (See his *De Pulsu, Resorptione, Auditu, et Tactu*, Lips., 1834, p. 173; and also his *Ueber die Lehre vom Tastsinne und Gemeingefühle*, 1851, p. 105.) And even to this day the facts seem to give no especial warrant for the logarithmic interpretation. If the least perceptible difference may be psychologically a variable, — in other words, since it is perhaps ever increasing as the sensation itself increases, — what is to prevent our believing that stimulus and sensation increase from threshold to acme in practically parallel courses, rather than that the sensation increases at a slower rate than the stimulus, as is so often stated in the text-books as the obvious meaning of the psycho-physical experiments?

experiments, and actually still in use, as I know, not far in the past. Other things that he used are treasured at the Leipzig laboratory, in what the assistants there humorously call the "reliquary" of the establishment.

Wundt and the work at Leipzig.

It is, in fact, at Leipzig that one next finds the main line of the experimental tradition. It was there that the first special laboratory for psychology was established by Professor Wundt, — a man who has for many years maintained a preëminent place among those interested in this line of research. Like so many others who have contributed to the development of this side of psychology, Wundt began as a physiologist, although even in his early writings one can detect an interest beyond the material processes involved. But the philosophical and psychological strain in the man's nature became manifest when in 1874 he published the first edition of his celebrated "Physiological Psychology," subsequently many times rewritten until it now consists of some twelve hundred pages and more. In this work Wundt has gathered together the scattered mass of psychological material, in large part from the experiments of the physiologists, and has added the rich results of his own experiments and of the band of workers whom he has had associated with him for many years. In 1879 he induced the University of Leipzig to set aside for him a small space for psychological experiments, and from this modest beginning has come his present laboratory of most impressive size and equipment. Wundt's laboratory,

moreover, is the parent stock from which a host of others of like kind have either directly or indirectly had their origin. The layman can get an impression of its activity from the fact that the *Philosophische Studien*, the official organ of the laboratory, has just closed its career after completing twenty solid volumes. Wundt himself has shown an astonishing power of stimulating the work and at the same time rendering it cautious and critical, and he will certainly always be counted one of the great figures in the history of modern psychology.

The importance of Lotze.

This historical sketch ought not to close without some mention of the name of Lotze, whose "Medicinische Psychologie" (1852) is an important forerunner of all our present physiological psychologies. The main current of the experimental stream came less directly through him than through Weber and Fechner; but he was a man incomparably larger than either of them, and must certainly be acknowledged as one of the great forces in developing the work,—his mind was so rich and frank and judicial in regard to the larger problems of the subject, and at the same time so appreciative of the details and bearing of minute scientific research. It would be well if all could preserve the fine balance and interplay of exact observation and large ideas which Lotze always showed. If one were to attempt to trace the intellectual ancestry of Lotze and to account for his philosophical breadth along with the sincere sympathy for the newer methods, this would undoubtedly lead us back through Herbart, with his attempt to found a mechanical and mathematical psychology, to

Leibnitz's spirit in the new work.

Leibnitz to whom no human interest ever seems to have been foreign, ranging as his mind did through metaphysics, mathematics, law, and theology, as well as through the minutiæ of practical concerns, whether of diplomacy or of calculating machines or of the shaping of optical lenses. May the experimental work in psychology always be worthy of its great progenitors!

CHAPTER II

THE GENERAL CHARACTER OF PSYCHOLOGICAL EXPERIMENTS

The relation of psychological to physiological experiments.

THE more striking influences that established the experimental method in psychology have been indicated in barest outline. The present chapter will be occupied in showing some of the important characteristics of psychological experiments, and first of all their relation to physiological investigations.

Why were physiologists the pioneers here?

Why was it that the experimental mode of investigating the mind came, in the first instance, chiefly from among the physiologists rather than from those upon whom psychology had a more immediate claim? The explanation itself is, I believe, a psychological one. The physiologists would perhaps say, as indeed many of them have said, that it is because they themselves have the only true method of getting at the mental life scientifically; that the only sure avenue to the mind is through the nervous system, and that the professional psychologists who until recently have always tried to get at the facts in some other way were of course doomed to failure. One can *experiment*, some have said, *only on the nervous system*, and the older introspective method to which the psychologists clung, naturally excluded the experimental procedure. For this reason experimentation had to begin outside the ranks of the psychologists.

A proposed explanation

which is wrong.

This, however, is certainly not the true explanation. For, as a matter of fact, there exists no inherent incompatibility between introspection and experiment. Was not Goethe's study of the effect of color upon the feelings experimental, even though the experiments were indeed very simple; and was it not also introspective? He used his variously colored glasses, and directly observed the inner moods that they occasioned. He did not get at the character of this mood indirectly by first noticing what effect the glasses exerted upon his nervous system. One may successfully perform such an experiment and a host of others infinitely more complicated, and be as innocent as a babe of nervous physiology; he might believe that he thought with his spleen or "reins," and yet be competent to tell that blue was sobering, while yellow and red roused like a bugle. This does not mean that one could at the present day master psychology as a whole and yet ignore physiology, for physiology has made some of the most important contributions of the time to the subject. But so far as the merely abstract possibilities of the case are concerned, experimentation might have grown up in entire independence of the physiologists—might have developed among those given to introspection pure and simple.

The fact remains, however, that the experimental method actually did not so develop, but came from the physiologists chiefly, and the psychologists finally adopted it because they found others getting psychological results by its means.

The explanation is to be found in the law of mental

habit. Psychology had for centuries been intimately connected with metaphysics, the same group of persons cultivating both fields. It was the most natural thing in the world, therefore, that the methods which alone are applicable to pure philosophy should also be employed in the subordinate work. If one could study metaphysics with acids and microscopes, psychology would have had its laboratories centuries ago. The physiologists, on the other hand, were already familiar with experimentation, led to it comparatively early because their problems more readily suggest the possibility of experimental attack, and also because the practical exigencies of sickness and of health make physiological questions more insistent than those of psychology. We must get exact knowledge of our bodies or suffer for it, while we can be in Egyptian darkness as regards our minds, and yet have contentment and long years. The close connection which exists between physiology and chemistry, one of the earliest centres of experimental work, doubtless also contributed to the same result. So that when a physiologist in order to solve his own problems had to approach them from the psychological side, as he often must, he naturally went to work by the methods to which he was accustomed and whose value had been so often forced home. The pure psychologists, on the other hand, were not accustomed to such ways, and therefore had to see the thing done before they could recognize its value.

Influence of training and habit.

It must be confessed, however, that the experimental side of psychology, whether it be in charge

Suspicious look of psychological experiments.

of those who call themselves psychologists or not, does to many persons look like a matter of physiology, pure and simple. For this reason it is not uncommon to hear this whole side of the subject spoken of as "physiological psychology," as if it had to do very largely with brain-processes and nerves. Many

Are they not physiological experiments in disguise?

of those who take this view doubtless feel in their heart of hearts that experiments of this kind must of necessity belong to physiology; that it is strictly impossible to experiment on the mind itself, it is so coated over with nerves and skull and skin, and that we can at best obtain by such experiments only some facts about the sense-organs or our nervous structure generally. This would seem to explain also the early precedence of the physiologists in the experimental work, as well as the fact that so many of our best modern psychologists began life as physiologists — Lotze, for example, and Wundt and James.

The way to allay this doubt.

Perhaps the best way to disabuse our minds of any lurking suspicion that psychological experiments are only physiological experiments in disguise, is to select some simple instance and analyze in careful detail its character and meaning. Much depends upon the selection, one must acknowledge; for some of our "psychological" experiments are undoubtedly nothing but physiological, and no time should be lost in trying to claim them for the mental side. There are others, however, which are *psychological* — are experiments on the mind itself, as distinct from its nervous basis. A single example of the right kind will be logically sufficient for our purpose.

FIG. 1. — Apparatus for determining the most rapid succession of light sensations.

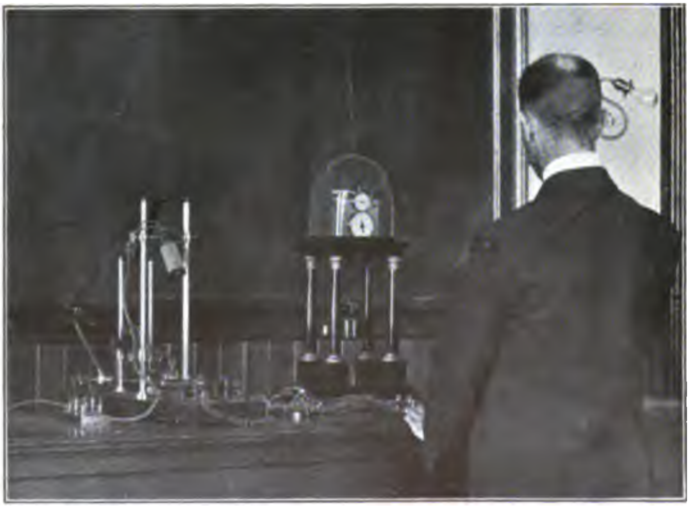


FIG. 3. — Reaction experiment. Part of the apparatus in the conductor's room.

Let us take a very humble experiment, then, — one that is as near the line between psychology and physiology as can well be imagined. If the problem may be put in a very concrete form, suppose we were constructing a kinetoscope and wished to know how many pictures a second would have to be reeled off to give the effect of absolute and unflickering continuity in the moving figures; or, to express it in a more general way, with what frequency must successive flashes of light come to the eye if they are to fuse into one uninterrupted impression. We arrange some simple contrivance — we look through a revolving disc with slits in it, behind which is a light, as in Fig. 1 — and gradually increase the rate at which the flashes come, until a point is finally reached where the distinct and separate impressions merge into one long unbroken light. This limit is found to lie somewhere in the neighborhood of forty flashes a second, but varies considerably according to the conditions of the experiment.[1]

Examination of an unfavorable example: the flicker experiment.

Now this is an old experiment among the physiologists, and most persons would, perhaps, be inclined to say that it is purely a physiological matter. It is simply a case of after-image or reverberation in the eye. When the flashes come so close upon each other's heels that the nervous excitation caused by one flash has not entirely passed away before the next one is upon it, there is a continuous stimulation of the retina, and the flashes fuse into one. The experiment merely determines the rapidity of the retinal process

It appears to be purely physiological;

[1] With a very bright light the limit runs as high as fifty flashes a second; with a very dim light, as low as twenty.

in the eye (such persons might say) and tells us nothing about the mind at all, except, perhaps, that the mind is subject to the eye's action and cannot experience the flashes as separate when the nervous excitations no longer keep apart.

If, in order to class an experiment as psychological, one had to make out an *exclusive* claim for it, such a showing as this would, of course, require us to surrender the experiment to the physiologists. But the fact is, the experiment belongs to both parties, and however much the physiologists may obtain from it, this does not diminish in the least what is there for psychology. The experiment certainly does reveal the behavior of the nervous coating of the eye; but how does it reveal this? Only indirectly, by first disclosing a peculiar psychological fact. In performing this experiment we cannot see the retina itself so as to say from direct observation that the nervous excitations outlast the flashes and finally fuse into one. What we do actually observe is that the *sensation* seems to become continuous, although from the conditions of the experiment we know that the light itself is being successively interrupted. The experience here does not correspond to the outer facts, and from this incongruity we *infer* the persistence of the retinal process during the interruptions of the light. The curious psychic effect, then, is the first thing observed, and the physiological part of the result is an afterthought, we might say, to account for this immediate psychological result. Strictly speaking, the physiologist is here getting at the nervous process by an indirect and psychological procedure. He cannot

yet it begins to disclose psychological features,

observe the nervous action itself; so, from an observer's report as to where the mental effect ceases to correspond exactly to the outer facts, he learns indirectly at what point the nervous shocks overlap and how long each persists after the outer light itself has died away.

and sheds light on remoter mental facts

So that along with the physiological bearing of this experiment, it makes evident an interesting fact of our mental life. It shows us that our visual impressions have an upper limit of, say, fifty separate sensations a second, and that we cannot, by any known contrivance, make them run with higher frequency. And this becomes the more interesting psychologically when it is seen to offer an explanation of certain other mental facts. Taken in connection with a similar experiment on our sense of hearing, we can explain why a lapse of time marked off by two flashes seems shorter than the same interval marked off by two clicks; this, in turn, may explain some further fact, and so the science of mental phenomena be furthered by experiments that seem at first to teach us only of our bodies and to have no connection whatever with the mind.

The flicker experiment further dissected.

In still another way this experiment might be shown to be justly of interest to psychologists. I am, of course, using this particular experiment merely as a type and as a means of making clearer the nature of psychological experiments in general. It is a fair example, I think, to assist us in distinguishing the psychology of our experiments from the physiology which mingles so freely with them. If we can bring out the difference here, even at the risk of mak-

ing some overdraft on the reader's attention, it will *a fortiori* be plain sailing in the more obviously psychological region of memory and pleasure and suggestion, which will be reached in later chapters.

Its results are not fully explained by the character of the retinal process,

From what was said a moment ago, it might seem that the facts that appear in the flicker experiment (as we may conveniently call the one with the flashes of light) could be fully explained by the physical process in the retina. The results, however, cannot be entirely understood in this way, and on closer examination become of even more interest to the student of mind. The experiment shows that when a frequency of about forty flashes a second is reached the flicker usually disappears. It might seem that this limit of forty flashes a second was determined by the character of the nervous process in the eye, and that, as soon as the successive excitations began to overlap, the flicker ceased. But if this were true, — if the overlapping of the successive processes in the retina were the complete explanation of the apparent continuity of the light, — then, instead of having to run our flashes up to a frequency of forty a second, four or five flashes a second ought to suffice. For the after-image of each flash certainly lasts a fifth of a second, and usually much longer. A boy with a glowing brand does not need to whirl it round the circle in less than this time to make what seems a complete ring of fire; the sensation lasts over the full interval and fills the gap. But why do we not lose the sense of revolution altogether and see only a steadily glowing rim? It is not because the boy cannot keep to his circle and, therefore, never returns exactly to the point of

beginning; for fasten the coal to a revolving wheel where the circle is perfect, and the motion is still seen. But even when the circle is glowing full round, the point where the ember actually is appears perceptibly brighter than the other portions of the circle, and we see this brightest point pass round and round, and so feel the movement, although the entire ring is all the while aglow. We are able to distinguish the brighter portion from the dimmer, and see it move. But suppose the boy could whirl the brand so evenly and so swiftly that the coal rounded the circle before the after-image had time to fade perceptibly dimmer than the coal itself — then the whirling would appear to cease, and we should see one steady, moveless ring. So with our flashes. It is not enough that they should come so close together that the second is there before the first has entirely died away; they must follow so swiftly, the one upon the other, that the second flash is there before the first has faded enough to be *perceptibly different* from the oncoming flash. It is not necessary that it should not have faded *at all;* some slight fading it is probably impossible to avoid, so long as there is even the smallest interval of time between the flashes. The fading must simply be too slight for us to notice it.

but are due largely to our power of discrimination

This, then, is the additional factor which helps to make this physiological experiment also a psychological one. The results we get depend not entirely upon the eye but also upon our power of detecting fluctuations in our experience. If our powers of comparison were less fine, then larger fluctuations of light would go unnoticed and the flicker would seem to die away

and to its particular limits.

with far less than forty flashes a second; if it were nicer than it is, the flashes would still appear to come in succession, even though we increased our rate to 80 or 100 or 1000 a second. A humble experiment like this, then, which at first seems so alien to the psychological realm directly teaches us far more of the behavior of the mind than of the nerves. It shows us not simply that there is a rapidity of experience beyond which we cannot go, but that this depends upon our power of comparison, and that here, too, there is a limit. There are differences in our sensations that escape us, not because they are too minute for our outer sense, but because they are too fine even for our "inner sense." We get indirect evidence that they are in the mind, but we can never directly notice them.

Summary of the psychological meaning of the experiment.

Distinction between psychological and physiological experiments.

Where you class an experiment depends, therefore, upon what you are seeking. For a person of physiological interest, this and many of our other experiments are purely physiological; he heeds only the nervous data which they afford, and the mental side is a mere lever by which to pry out the hidden bodily facts. Another person using the same apparatus and performing the same acts is watching all the while the working of the mind, and for him the investigations are psychological. For this reason psychological experiments, in their purpose and results, although not always in their apparatus and procedure, are different from physiological research. In making such a distinction, however, there need be no thought of relative value or superiority. It is not that psychology would be defiled if found consorting with the

flesh; but only that there would be no logical justification for speaking of *psychological* experiments and *psychological* laboratories, if in reality all such work contributed only to our knowledge of the nervous system and told us nothing whatever of the mind.

But is not the work confined to the beggarly elements of mind?

But those who admit that there really is a psychological side to these experiments are often quite convinced that the field of the work is extremely limited, and has to do only with the beggarly elements of mind. This conviction arises from the fact that the experiments always involve the use of the senses. Whatever the mental process we are experimenting upon, — whether it be our sense-perception or memory or discrimination or our feeling of pleasure, — the apparatus is always contrived to play upon our sense-organs. Colors are presented to the eye, tones come to the ear, strips of paper or of wood are offered to the touch. Fastidious spirits, on noticing this characteristic of the experiments, have often been offended by them; the work seems to cling to the earth and to miss the higher flights of our mental life. If the experimental work be not physiological outright, they hold, it can at least never get above the basement levels of the mind. Since the apparatus always operates upon the senses, this new method, it is urged, applies only to sensational processes, to tasting, smelling, hearing, seeing; while the higher operations in which we are chiefly interested, — conception, imitation, thinking, preference, — all these must necessarily lie beyond its reach.

The subsequent chapters will, I hope, be the main

An illustration in reply.

disproof of this. But to illustrate how mistaken the view is, and how easily an experiment may pass beyond the bare process of perception, even though the apparatus primarily gives only impressions of sense, let us take an experiment on our power to recall the temporal order in which a series of experiences occurred.

Experiments with colors

Some simple contrivance is used for showing at the same opening of a box a series of, say, eight colors at slow and regular intervals, and thereafter, on completing the series, any one of the colors, haphazard, is shown a second time, and the person experimented upon is asked to tell at what place in the original series this special color appeared. Now if the colors of the entire series be of the familiar sort that are easily recognized and for which we have ready names, — like red, green, orange, — the number of errors which will be made in recalling the place of the single color in the series is much smaller than when the colors are of rare and less readily namable hues, like drab, buff, and olive.

or forms

And to show that the results here are not due to the particular colors, we may use instead various black and white figures. For the more familiar group let us take our ordinary English letters, — K, S, B, M, F, P, H, C, for example, — and as a contrasting series, difficult to name and classify, we may employ such nonsense characters as are shown in Fig. 2, which are certainly as striking and as distinct *inter se* as are our familiar consonants. The results, however, are the same as before; the order of the unfamiliar forms is much harder to remember than that of the letters. In these experiments the

apparatus seems to appeal only to the senses; it offers bare impressions to the eye. And yet, in spite of this, the actual result is to bring out an interesting peculiarity of the mental process of recalling and

FIG. 2.—Forms for experimenting on memory.

"placing" an item in a time-series. It tells us nothing of our sensuous nature.

may give evidence of deeper mental traits.

For no one can suppose that the less familiar colors and shapes make a less living impression upon the eye, and for this reason are more difficult to remember. The larger number of errors here is rather due to the intellectual confusion we feel while the series is being given; we hesitate over their names and character, and in the end have but a vague recollection of the order in which the series ran. The retention of the arrangement of such things is, to put it otherwise, largely a matter of recognition and verbal association; especially when, as in the present instance, all logical or causal connection of the various members of the series is rigidly excluded.

Why the experiments are so doggedly sensuous.

To the careless onlooker we might seem here to be experimenting on one's eyes, but in reality it is an experiment upon the influence of recognition and verbal associations on our retention of a series in time, and the results reached are doubtless applicable to any series whatever, whether of sights or of odors or of the most abstruse conceptions in mathematics or theology. The colors and letters are mere *corpora vilia;* we can readily get them into the laboratory;

own — something apart, and not to be contaminated with the results of mere observation. In discussing the various questions upon which experimentation casts an important light, there will consequently be no attempt to look at these problems exclusively in this light. If the experimental side is emphasized, it is not in a party spirit; there is no question of principle involved, and there is the freest admission of the value of other modes of attack.

CHAPTER III

THE POSSIBILITY OF MENTAL MEASUREMENTS

The problem of measurement is momentous for psychological method.

THE subject of this chapter plunges one into the heart of the experimental work. To many the success or failure of the new departure in psychology seems to hinge on the question whether mental facts will permit of being *measured*. If these can be measured, they would say, then and only then is it possible to have a scientific study of the mind. It is not enough that we should be able to perform experiments; our experiments must be capable of giving us results that are *quantitative*. In the old school they were satisfied with determining the qualities and kinds of mental facts, but now we must discover their nicer mathematical relations. Psychology must have something comparable to the exact weights and volumes and durations with which the physical sciences deal and to which they owe their great success. It is held that unless we can make measurements in the mental realm similar to the quantitative researches in chemistry and physics, we are no better than our fathers, and the modern turn in psychology brings in no essentially new resources by which to lay bare the structure of the mind. The question of quantitative results in psychology is therefore a living one; it touches the subject in the quick. And while some

of us may think that those who regard this issue as a matter of scientific life and death are taking it perhaps too seriously; yet, short of life and death, it is as important a problem of method as the experimenters have to confront. Experiments can certainly proceed even if exact measurements should prove impossible, but it would be a halting progress and a great disappointment to those who have heralded the new methods as the beginning of nicer and more fruitful work in this difficult field.

Psychic measurement is declared impossible.

The question is one upon which there are honest differences of opinion. No less a person than Kant, for instance, believed that mental measurements were an *a priori* impossibility. Those of opposite view may speak patronizingly of him as of one who lived under the old dispensation before our psychological laboratories had shown what was the range of possibilities in the case. But we cannot so readily explain similar views which persist to-day even amongst those who are familiar with all the details of the experimental work. Some who are entirely at home in the laboratory methods are still in perfect agreement with the Kantian doctrine, and when it comes to the question whether there are any strictly mental measurements in our modern researches, they answer with an unequivocal No.

Common-sense difficulties.

Our common-sense prejudice, I think, is apt to make us sympathize with this negative side of the matter. Probably most of us have an instinctive conviction that we can measure only the things of the physical world; we can measure land or indicate degrees of temperature, and we understand what

is meant by the weight of the human brain. But what should we mean by the literal metes and bounds of a man's mental life, or by a quantitative estimate of one's spiritual acts? The use of mathematical language in regard to such things has a humorous effect, as when Plato tells us in the "Republic" that the just ruler is found by elaborate computation to be exactly 729 times happier than the tyrant. The facts themselves seem too vague and elusive for such treatment. Moreover, measurement seems to imply the application of the measuring apparatus to the object. But where, as in the present case, the facts to be measured and our instruments of precision lie in totally different realms, what result can we ever hope to attain? In some such way we might express the doubt that arises at the bare mention of the proposal.

Metaphysical objection.

There is, however, a metaphysical objection that attacks the possibility of measurement in a much subtler and more radical way. The common-sense objection is of a practical nature — the practical difficulty of bringing our measuring rod and our psychological object into the same sphere and of applying the one to the other. But the more philosophical objection is, that even if we could carry our instruments into the mental realm, we should find nothing there that could possibly be measured. The very nature of mental facts is such that they are not subject to measurement. The difficulty now is a logical rather than a practical one; it is asserted that there is an inherent absurdity in the very thought of measuring mental things; that between the notion of mind and the notion of measurement there is, to use Berke-

ley's phrase, a manifest repugnancy: the one conception cannot tolerate the other. Measurement always implies that the thing to be measured is *quantitative* and may be stated in numerical terms and manipulated mathematically. The facts of mind, however, it is maintained, exclude any such idea; they are not quantitative and are therefore not measurable. Mathematics is inapplicable to the mental life, and for this reason psychology can never hope to attain the status of a science.

This, in brief, is the *a priori* objection to all measurement in the mental field. It springs perhaps ultimately from a definition of the soul, as given in metaphysics. The soul is a simple substance, the metaphysics of mind has often taught — a simple substance without parts and without extension. Such a description readily suggests that the soul has no quantum, and that measurement in its case is meaningless and impossible.

Need of examining instances of measurement.

The most telling refutation of such an argument is to do the thing that is alleged to be impossible — to prove that you can walk by walking. And this is the answer on which the experimenters, in the main, have relied. They are inclined to show their method and its results and to invite one to draw his own conclusions. And we may follow them to the extent, at least, of postponing the consideration of the various theoretical difficulties until we have the character of the experimental work more clearly before us. We had better take up in some detail a number of characteristic experiments of the less complicated sort, and then, by a careful analysis, try to decide whether

they actually escape the grave objections that can be raised against the quantitative work.

A warning as to their aim.

It is perhaps unnecessary to warn the reader that experiments in this field are less ambitious than some may have been led to expect. There is no thought of measuring one's mind as a whole, nor of determining its general range and efficiency. The expression "mental measurement" might suggest such a thought to the unwary. But if for this reason it seems objectionable, it is at least an improvement on an older term which at one time bade fair to be the designation for all this kind of psychological work — the term "psychometry." This word has fallen into disuse because it almost justified the belief that the laboratories pretended to some sort of mental caliper by which to determine the gauge of any given mind. An additional reason for discarding it was that the theosophists adopted it to denote perhaps no one could say what, except that it was something totally different from what the psychologists ever intended. In mental measurements, therefore, there is no pretence of taking the mind's measure as a whole, nor is there usually any immediate intention of testing even some special faculty or capacity of the individual. What is aimed at is the measurement of some limited event in consciousness, such as a particular perception or feeling. The experiments are addressed, of course, not to the weight or size of such phenomena, but usually to their duration and intensity.

We might first consider, then, some experiments which aim to measure the time of psychic phenomena.

I. Examples of time-measurement.

Without any apparatus at all we should be able to say that the duration of our mental processes varied enormously; that to-day we can go through a mental operation in a few moments that once would have required hours. And if we were to attempt to measure accurately by instruments the time required for some of our acts, we should have to use nothing short of an eight-day clock. The actual laboratory work in time-measurement, however, has been narrowed down to determining, not the time in general that is occupied by some mental action, but rather the shortest possible time in which a particular operation, like discrimination or choice or association or recognition, can be performed under the simplest and most favorable circumstances. The experimental results here are something like speed- or racing-records, made under the best conditions of track and training. A delicate chronograph or chronoscope is used, which marks the time in thousandths of a second.

Apparatus and method.

The method generally employed is that of a "reaction" experiment, already alluded to in speaking of the astronomical observatories and the psychological experiments on personal equation. Some suitable object is suddenly disclosed to the attentive observer, he goes through a prearranged mental operation, and immediately at its completion moves an electric key on which his finger has been resting. The chronometer records the time between the display of the object (at which time, approximately, the mental process began) and the subject's movement which signals the close of the mental act. The time recorded, after making certain necessary corrections to be considered

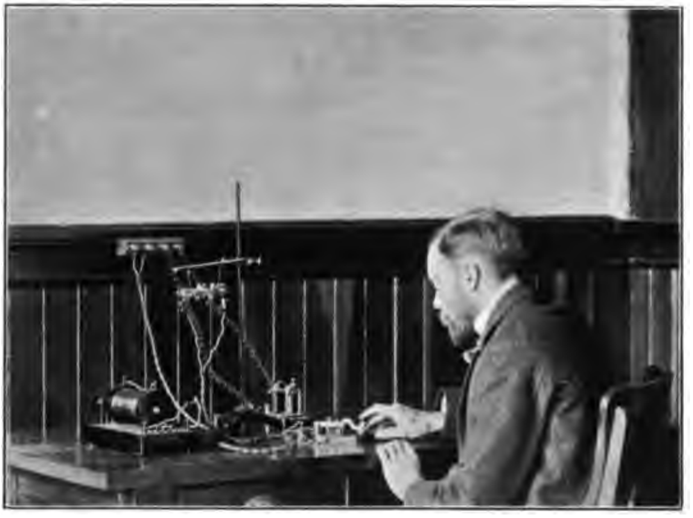


FIG. 4. — Reaction experiment. The arrangement in the subject's room. In actual experiment the room would be darkened.

FIG. 9. — Apparatus for crossing the threshold of sound. In actual use the telephone would be in a distant room.

directly, is assumed to represent the duration of the mental operation with which the experiment was concerned.

Reaction to light.

To take a definite and concrete case, suppose we wish to ascertain the time required for a person to become conscious of a light suddenly flashed into his eyes and to give a muscular impulse to his hand as a sign that the light was seen. An experimenter with his electric chronometer and connections, as shown in Fig. 3, is able to give a flash of light in a distant room and to record exactly the time when the flash was given. The person experimented upon, sitting ready and expectant (Fig. 4), moves an electric key, and instantly this "reaction" is recorded on the chronometer in the experimenter's room. The time between flash and movement would in the present case perhaps amount to from 180 to 280 thousandths of a second, according to the person's method of reacting.

Results.

Now from such a record as this, supposing it to have been checked and corrected by many hundred similar experiments, what do we learn as to the time occupied by the mental process of receiving and responding to the flash? First of all, we know that the mental operation has occupied by no means all of these 180 to 280 thousandths of a second. A considerable part of the time has been used in the purely mechanical process of transmitting the message to the brain and of conveying the message back from brain to hand. It takes some time for the light to start a nervous excitation in the eye; it takes additional time for this excitation to pass along the optic nerve to the brain and up through the brain to its gray surface. Not

Necessary subtractions.

until this region — the cerebral cortex — has been reached is there any consciousness of the light. So that if our time-record were confined to the purely psychic and cortical part of the operation, it should begin, not with the external flash of light, but with the arrival of the message in the central office, when it reaches the gray matter of the hemispheres. And likewise with the transmission of the reply. If we could exactly mark the time of the mental process, our record would close at the instant the message had become formulated in the subject's mind, and the corresponding operation had taken place in the cortex. But instead, our clock keeps on and includes the time while the answer is coming from the motor region of the brain, down through the deeper cerebral centres and the spinal cord and along the motor nerve out to the muscles that finally cause the finger to respond. The chronometer thus records a considerable amount of dead time — of time not required to begin and end the mental and cortical part of the work at all; and to get at the time of the mental operation, this dead time would of course have to be deducted.[1]

[1] In this chapter the timing of mental processes is illustrated only by the reaction method. There is at least one other way, however, that avoids some of the theoretical difficulty which the reaction method undoubtedly has. The flicker experiment of the preceding chapter, for example, might serve as an instance of timing our mental acts by a non-reaction method. It shows that the least noticeable fluctuations in vision can occur with a frequency of 20 to 50 a second, and therefore that each separate process occupies between 50 and 20 thousandths of a second. The view proposed in the text that there is here a kind of rudimentary *discrimination* of the successive intensities is to

Such measurement is of value not alone from its inherent interest, but as a starting-point for further work, in approximating the time of more complicated processes. One may next investigate the time required not merely to receive the mental impression of light in general, but to recognize the kind of light, whether, for instance, it be red or blue or something else. The general character of the experiment would be the same as before, except that instead of repeating at each trial the self-same kind of light, the subject now never knows beforehand what the color of the light will be. At first he will probably be flurried, and his reaction will not be exactly according to programme; but in time his nervousness subsides and he settles down to regular responses in which we can be reasonably certain that his reaction is not made until after he has discerned the color of the light, whereas at the beginning he may have reacted at the bare coming of the flash regardless of its hue. The time between light and reaction will under these circumstances lengthen perhaps to 310 thousandths of a

A foundation for further work.

Recognition time.

some extent confirmed by the fact that these numbers (20–50σ) are not far from those obtained for discrimination or recognition (the two are not very different) by the reaction method. Titchener, for instance, working by the reaction method (*Philosophische Studien*, Vol. VIII, p. 138), found that the recognition of a color takes place in about 30σ. Cattell calculates from his reaction experiments that the discrimination of white light, when the kind of light had not to be discriminated, required for Subject B, 30σ; for Subject C, 50σ (*Philosophische Studien*, Vol. III, p. 455). In the flicker experiment the interval is obtained without the need of computing what I have called the "dead" time, so that this particular difficulty is avoided. But the method is not so widely applicable as the reaction method has been found to be, and is therefore on the whole less attractive.

second, as against 280 with the same observer where no recognition of the colors had to be performed. It is fair to assume that the increase of the interval — the difference between 280 and 310 thousandths — is the time required for this additional act; for in other respects the experiment has remained unchanged.[1]

Association time.

By a similar modification of the reaction experiment, the details of which it is not necessary to describe, it is found that for an association of distinct ideas to arise in the mind (for "ship" to remind us of "sea," for example, or for "north" to recall "south") the reaction-time lengthens to a period ranging from 1.009 to 1.154 seconds in certain observers. It is interesting to note that if the person upon whom we are experimenting is instructed beforehand to confine his associations to certain definite directions, the process takes less time than when he is given perfect freedom to let in associations riotously from any point of the compass. If, for instance, he be required to call up some association that stands to the idea given him, in the relation of part to whole and we then give him the word "bear," he will get a definite association such as "skin," or "paw," in a shorter time than if he had the option of calling up an association of any kind whatever, like "mammal," "fur," "North Pole," or "honey." The very number of things coming, in the latter case, seems to choke the avenues of the

[1] For concreteness' sake I have taken the numbers here from the experiments on Professor Titchener, as reported by himself. They are fairly typical. See his "Zur Chronometrie des Erkennungsactes," *Philosophische Studien*, Vol. VIII, p. 138.

mind; the crowding ideas produce an instant's deadlock and confusion, whereas if nine-tenths of them were excluded at the outset, some one idea would rush through the gates the sooner. It seems to be an instance, on a small scale, of what appears in common life where men of limited view — "men of one idea" — are so often of great practical efficiency, while those of wider mental range can perform nothing of importance without first rejecting a host of suggested lines of action. If quickness were the one thing needful, rigid habit without options would be our best equipment; for freedom of selection always means an initial hesitation and loss of time.

II. The measurement of psychic intensity, e.g. in color contrast.

As an example of experiments dealing with the intensity of a mental fact, we might select the phenomenon of color contrast. It is well known that any color tends to cast a complementary hue over surrounding objects that are not themselves highly colored. Shadows near bright colors take on these complementary tints in a striking way, since the shadow is subdued and more neutral in tone and therefore offers little color of its own to resist the contrast influence. For this reason shadows near green foliage or on the green sea or on brown or golden fields show a distinctly purple or violet hue, and in some of our modern works of art these contrast purples have been brought out in such regal splendor that little else can be seen.

Now contrast of this sort is a psychological effect (although doubtless mediated by physiological conditions), and, in a way, it can be measured. For experimental purposes it is more convenient to reproduce

the phenomenon on a small and unimposing scale with a revolving circular disk of paper arranged as is shown in Fig. 5, where there is an inner and an outer zone of some bright color, — say green, — and a middle portion composed of alternate black and white segments. When the disk is rapidly revolved by an electric motor, these colorless segments fuse into a single uniform ring; but instead of this middle band appearing a neutral gray (as a mixture of black and

FIG. 5. — Disk for the production of color contrast. If the two cross-hatched zones be of bright green, the zone made up of black and white will upon rapid rotation take on (by contrast) a reddish hue.

FIG. 6. — Disk for the measurement of the contrast effect in Fig. 5. The cross-hatched segment represents red, which may be varied in amount until the middle zone on rapid rotation matches the middle zone of Fig. 5.

white should), it is seen to be decidedly tinged with red. If we cover the two green portions of the disk, the zone between them at once becomes colorless, showing that the reddish tint is a contrast effect due solely to the neighboring green. To measure the amount of this contrast hue, we set beside it another revolving disk which likewise has three concentric zones (Fig. 6) but whose inner and outer rings are colorless, while in the ring between them there is a variable sector of red which permits us to change at will the proportion of red and gray in this middle zone. By this second apparatus we can thus produce a series

of grayish reds until we have approximately matched the reddish tone that appeared on our first disk by contrast. It is now found that from thirty to fifty degrees of the red sector must be exposed in the grayish ring of the measuring disk to produce an effect equal to the mere proximity of the green. Experiment shows that the number of degrees required for a match differs according to the person, the kind of green we use, the shade of gray, and various other conditions of the trial. It is in any case but an approximation, and I shall indicate later with what caution inferences should be drawn from these and similar results.

III. Measurement of space discrimination, e.g. in the blind.

A single additional example of measurement will suffice. We all know that the blind show an astonishing cleverness in using their sense of touch. Does their superiority to us lie in the fact, as some have thought, that their finger-tips have developed a much finer nervous structure than ours? If so, experiment ought to show that impressions so close together as to be quite indistinguishable for us were still separate enough for their finer sense. We should make careful experiments on the blind and on normal persons of like age and intelligence and of similar manual employments, to find what is the least space difference that each class can discriminate.

By measuring the spatial nicety of their skin with compass-points, — that is, by finding how far apart the two compass points must be for the subject to feel them as two and not as one, — we learn that in children (whose sensibility in this respect is in general finer than that of adults), it is necessary to open our

compasses a little more or less than one millimetre (about one twenty-fifth of an inch) before the two points seem to lie on distinctly different places on the skin, — a result practically the same as that which we get by similar experiments on children who can see.[1] There is, perhaps, a slight advantage on the side of the blind, but nothing sufficient to account for their deftness in using their sense of touch, as in reading. The tactile superiority of the blind is not due, then, to some extraordinary development of the organ of touch. They do not obtain through their fingers inconceivably finer gradations of impression than we do, but by long practice and attention they have learned to see a world of meaning in the very impressions which we receive as tame and unsuggestive, distracted as we are by the more interesting sensations of light and color. The blind have little if any greater nicety of the sense itself, but infinitely greater readiness in understanding the *meaning* of what the sense reports.

[1] This result, already indicated by earlier experiments (cf. the authorities in Heller, " Studien zur Blinden-Psychologie," *Philosophische Studien*, Vol. XI, p. 226), has been confirmed by the experiments of some of my students, courteously aided by Dr. Wilkinson, the superintendent of the California State Institution for the Deaf and Blind. Miss Katharine Bunnell, working with five blind subjects and five normal persons, and Miss Agnes Stowell, with a separate group of subjects (eight blind and eight normal), find the thresholds to be but slightly in favor of the blind.

As regards the least *pressure* that can be perceived at all — a question to which experimenters on the blind have given far less attention — there appears to be a decided advantage for the blind, according to some preliminary experiments by one of my students, Mr. Otto Schulze. As to the meaning of this, I should prefer to reserve judgment, however, until the results are quite beyond doubt.

It is as in the case of language, where the same sounds give such different results according as they are or are not of our mother tongue. In listening to a language, the native and the stranger are on an equal footing so far as the mere sense of hearing is concerned; and yet, even when the stranger knows the tongue quite well, he must stand nearer a speaker in order to understand him. The native can disentangle the snarl of sounds, can catch the significance of slight differences which to the other are as good as lost. Our experiments in measurement give some hint, then, not only of the general character of quantitative work in psychology, but also of the use to which the results can be put in clearing up more complicated mental problems.

Return to the original question: Do such experiments really measure mental processes?

With these instances of laboratory measurement we may return to the question raised at the beginning of the chapter. Can such experiments justly claim to measure mental phenomena, or must we, in spite of them, reaffirm that quantitative notions are absolutely alien to the mental realm? We are now in possession of the main facts of the case, and must next try to render some decision upon this question. Here the hard work fairly begins, I fear, and the reader must prepare for a somewhat trying review of the various difficulties in this subtle but important problem. After all, a closer examination of the theoretical objections to the experiments in measurement is the best means of seeing what the experiments themselves really are.

And, first, is there any psychic quantity to measure?

The hottest of the dispute has been over the

Review of four kinds of quality available:

1. Intensity.

intensity of psychic processes, and more particularly over the intensity of sensations. For no one, so far as I know, has ever seriously claimed that there is any intensive character to the mental activity whereby things are held in relation and bound into wholes,— as, for example, the mental act of connecting two ideas logically, as subject and predicate in a judgment. So that intensity is to be found, if at all, in sensations and feelings—in the *materia prima* of consciousness, rather than in its "form."

The claim that every mental phenomenon is one and indivisible.

Fechner's famous elaboration of Weber's Law proceeded on the assumption that the intensity of any sensation is a definite quantity made up of a certain number of units of intensity, and that sensations of different strength might in this way be mathematically compared. This assumption, however, has been denied *in toto*. A sensation, it is claimed, is not made up of a number of units. Within the sensation which an arc-light gives, for instance, we cannot discern a number of weaker sensations, each like the light of a tallow candle. A loud sound, as an experience, is not composed of smaller faint sounds; we cannot break it up into a weaker sound plus a certain increment; it is an absolutely indivisible and unitary experience.

But so is a tree, strictly speaking.

This is certainly a forcible argument, and yet I am not sure that we should give it decisive weight. For might we not similarly point out the absurdity of attributing spatial quantity to trees, since a big tree is not a collection of little trees, nor can we break the large one up into a smaller tree plus a certain increment; the larger tree is not a compound, it is a single

and unitary thing. And yet it is not the less a space-extent. So that even if we admit that each mental event is something entirely unique, this does not preclude its having some single aspect — like that of quantity — common to other mental events. Anything in the world, whether it be a tree or so simple a thing as a sensation, has many sides, and nobody should pretend that the quantitative aspect is more than a single one of these, hidden among many others, and recognizable only by a subtle process of abstraction whereby the numberless differences and contrasts between this and other objects are for the time neglected. One need not discover little trees in the large one, nor even yardsticks in it, in order to attribute to it linear quantity. We neglect the difference in wood between the tree and the yardstick; we neglect their difference in shape and color, as well as the fact that at bottom a tree is not a compound but is an organic unit, and cling to the sheer abstract extent which both objects display. Similarly the loud sound undoubtedly does come to us as a unitary thing and not as a compound. It arouses feelings and impulses that are totally different from those of a faint sound, so that as an experience it has a peculiar quality and flavor which the other lacks. And yet this does not argue that the two lack the single common feature of strength as a strictly quantitative matter. Whether it is possible to measure and mathematically express their relative strength — that is another question, to be discussed later. Here we are concerned solely with the high-handed objection that there is no quantity in mental

An indivisible experience may be quantitative.

things to measure, and that we may consequently without more ado declare all attempts to measure them futile and absurd. And so far as the present argument goes, we may bring in a verdict of not proven.

Yet even if intensity should fail us, all is not lost.

It ought perhaps to be added, that this particular question in regard to the *intensity* of mental processes does not seem to me so vital for even our laboratory measurements (not to speak of the large amount of work that does not pretend to measure anything) as many have supposed. The justification of the quantitative work does not stand or fall according as we can allay all doubt of the existence of intensive quantity in sensations. For even should we concede the whole point, there still remain plenty of other kinds of quantity (such as temporal, spatial, and merely numerical quantity) to give scope for research in measurement. And as a matter of fact, the most systematic attempt that has yet been made to sweep away the notion of intensive quantity from psychology does not, in the end, really exclude all quantitative character from our sensations, but simply reduces intensity to quantity of another sort, to differences of time and space. According to this attempt at reconstruction, a loud sound seems to be more intense because it occasions in us reflex muscular contractions of longer duration and of wider extent than does a faint sound. The involuntary muscular reaction persists through more time or is diffused through more space, and this purely temporal or spatial difference in the muscular accompaniment somehow casts its shadow over the auditory impression and gives to it the peculiar appearance which we call its intensive

character. Passing over the obvious difficulty here that our muscular sensations seem also to have intensity in addition to their temporal and spatial character (so that we are as far as ever from ridding ourselves of intensity), the question sifts down to one of classification, — whether intensity is a special and separate kind of quantity, or can be reduced to one of the other kinds; and the experimenters can work as contentedly under one answer to this problem as under the other. It really makes little difference to them whether psychic quantities be thrown into one group more or one group less. That there should be quantity at all is the main thing; not that there should be quantity of this or that particular name.

a. Spatial quantity in the psychic realm.

As to the existence of *spatial* quantity in the psychic realm, it has been usual for psychologists to make no claim in that direction. Physical things, it is held, have shape and size and position; but mental processes not. Our thought of a quart is not a larger thought than that of a pint. Our conception of the north pole does not lie to the north of our conception of the south pole. The idea of half a circle is not a semicircular idea, etc.

Arguments *contra*.

There certainly is no disputing these propositions. But they do not prove that space-relations have no place in psychology; they merely show that space is not a *universal* form of our mental processes. For we could as well argue that mental facts have no time-character, since our idea of a century is not itself a century long; or that color is a purely physical phenomenon and not at all a psychological one, since our idea of green is not a green idea.

A distinction. The confusion clears up somewhat when we distinguish between the object in mind and certain deeper mental processes that play around this object. Now space-character may justly be attributed to the object we have in mind, and yet be confessedly inapplicable to the higher mental activity that stands above and around the mental object or contents. In other words, some of our more elaborate processes do not have the same characteristics that the particular *constituents* of these processes possess. And consequently when we have shown the absurdity of assigning spatial quantity in the one case, we are far from driving this quantity quite out of the psychological field.

Difficulty of denying space-attributes to the mind. Such an expulsion would be easier if there were not so many space-objects that have their existence only in consciousness, so that their spatial character cannot be coolly turned over to the physical world. The peculiar shapes and dimensions of many figures are sheer figments of the mind, as in our dreams or in the normal illusions of our waking state. The quantitative aspect of these objects is clearly a mental affair, and any measurements we might perform would be a psychological measurement, pure and simple.

Illustrations. The interesting illusion that goes by the name of Zöllner's figure might illustrate such a non-physical spatial quantity. In this illusion parallel lines cease to appear parallel as soon as they are cross-hatched, as in the accompanying diagram (Fig. 7). The apparent displacement of the parallels amounts, in my own case, to an angle of about four degrees. So that if the diagram be changed four degrees in the opposite

direction to offset the illusory effect (as in Fig. 8), the lines appear to be parallel. The disturbance caused by the cross-hatching is a psychological fact, and is quantitative and spatial. It may, in the end, be due to some purely intensive effect of the cross-lines upon the muscles of the eye, although probably not; but as we experience it the illusion is *spatial*, and as

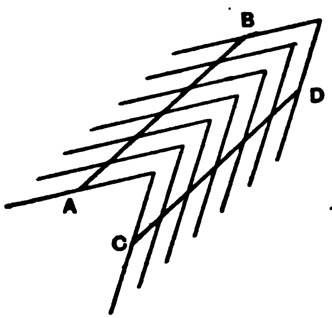


FIG. 7.—The lines AB and CD are really parallel.

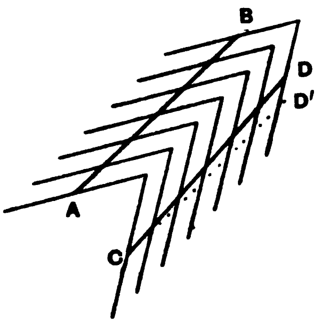


FIG. 8.—The lines AB and CD converge upward. The psychological effect of the cross-hatching is measured by the angle DCD′, since CD′ is parallel to AB. ($\angle DCD' = 4^\circ +$).

such we have to describe and measure it. Similarly the apparent enlargement of the sun and moon when near the horizon is, in all probability, a mental phenomenon, and is of course spatial. So that it would not seem amiss to make spatial quantity a valid category in psychology; but valid only within limited regions, as has been said, and not of universal application.[1]

[1] I have the less hesitation in presenting these conclusions in regard to the spatial character of mental phenomena, as well as in regard to their intensity, since finding that my view is in essential agreement with

3. Temporal quantity.

It is less difficult to convince ourselves that *temporal* quantity has a place in the mental realm. It is true that for certain ends it is often necessary to regard the mind *sub specie æterni*, and to neglect that side of it that shows duration and change. But whatever aspects of the mind there may be that are timeless, they are certainly not the ones with which empirical psychology has most to do. Psychology is largely concerned with acts of attention, with pleasure and pain, with the processes of perception and memory; and can we justly maintain that these in their secret essence are timeless? They have all the characteristics of events in time; they come and go; some are brief while others persist; they come together; they come in succession. A recent writer has denied that mental phenomena are temporal; but it is difficult to see any better reason for this than there would be in the case of the phenomena of physics or of astronomy or of history. Psychology has as good ground for assuming the reality of time within its own field as have any of the sciences.

Reasonableness of assuming it.

4. Quantity of simple enumeration

And finally, if we are to complete our review of the quantitative aspects of the mind, we shall have to include still another, and that the most abstract of all. Professor Howison has clearly shown that wherever any real differences exist, there the fundamental notion of quantity, that of *number*, finds a

that of so able a writer as Mr. F. H. Bradley. See his two articles in *Mind* (N. S., Vol. IV, 1895) entitled respectively: "In what sense are Psychic States extended?" and "What do we mean by the Intensity of Psychic States?"

place. In this widest sense, quantity pervades the mental world as truly as it does the physical.[1] For in neither realm is there monotonous uniformity; on the contrary, there are distinctions and contrasts, and so the basis for number is at hand. As regards numerical quantity, then, we do not have to make the reservations that were necessary in some of the other cases. There is no department of the mind that it does not penetrate. Hegel has shown that quantity is next-door neighbor to quality, and that as soon as anything possesses character it is *ipso facto* entering the quantitative field. The great theological debates, whether God is one or many; the problem of Monism and Pluralism, of Unitarianism and the Trinity — these are evidence of the exalted region into which men have felt that the notion of number goes. Whether there are real and abiding distinctions within the very Godhead, has seemed to many thinkers a relevant question. To escape it we should have to adopt something like the mystical view that spirit lies in a realm where none of our human predicates applies; that it is neither one nor many, nor many in one, but is ineffably higher than all such marks. But certainly no psychologist can consistently accept this view as applying to the mind as we actually know it. For psychology is an effort to understand the mind, to map off and tabulate its different appearances and events. And those who carefully examine the subject believe that many differences and contrasts and variations in conscious-

pervades the mental realm.

[1] Howison, "Philosophy and Science," *University Chronicle*, Vol. V, p. 129.

ness are discernible. A process of reasoning is one thing, a sensation of pain is another; each is one and the two are two. And in the flicker experiment, described in the preceding chapter, some thirty mental events occur in a second. The fact, however, that most of our mental phenomena dawn and change and almost insensibly fade away and, at best, have but the vaguest outlines is no better ground for denying them quantity than for refusing it to the clouds because they are often ill-defined and merge and vanish in thin air.

But even though psychic quantity exist, is it measurable?

There seems, then, an irresistible cumulative evidence that mental phenomena are quantitative. The remaining and more practical question is whether this quantitative character is really measured by our laboratory experiments.

Doubt because of the inaccuracy of our experiments.

Perhaps the readiest doubt would be on the score of accuracy. The illustrations given earlier in this chapter indicate the difficulties and embarrassments under which psychology labors in this regard. Our results certainly make a poor showing in comparison with the marvellous exactness which marks the best physical measurements. In computing the amount of purplish red cast over the gray by contrast with the green, — one of the examples of psychological measurement given some pages before, — if we carried out the measurement in all its details we should be struck by the impossibility of making any very exact determination of the amount of red the green induced. In our attempt to match the red, we should find that, when once we had reached a certain point,

a few degrees of red more or less in our measuring wheel would not disturb the match to any appreciable extent; it would seem satisfactory regardless of the exact amount of the red sector displayed, provided we kept within certain limits. In any single measurement, therefore, there is always the probability of a considerable error. And this holds true of all our other psychological measurements,—in the examples of experiments on the tactile sensibility of the blind and in the chronometric work which at first sight might seem to an untrained person a marvel of accurate investigation. Judged by the standards of astronomy or of physics, however, such work is crude enough, and marks off the result as by a ploughshare where the others can use a graver's tool.

Even exactness can be overvalued.

But admitting all this, I feel that too much stress can be laid on a matter so important, even, as that of accuracy in measurement. Exactness is certainly a vital thing, and the psychological work must become vastly more refined. But accuracy is relative, after all; and what we call the exact physical sciences appear so only because we have no absolutely exact measurements with which to compare theirs. Even in astronomy the measurements are, strictly speaking, but rough approximations. Yet the errors here offer no insuperable obstacle to reliable generalizations. Copernicus and Galileo in their most lasting work doubtless relied on observations which would be considered crude if judged by the standards of our modern observatories, and cruder still could we but look back upon them from the vantage of the coming

All measurements are inexact.

years. It is, therefore, no fatal objection to our psychological measurements that they are comparatively rough. Moreover, increased success is constantly being attained in excluding various sources of error and in measuring or estimating the amount of the errors themselves. When once we know how large the error in any given instance is, it often ceases to be a serious disturbance. As far as the special problem in hand is concerned, we may proceed as if the results were accurate to a hair. If we found, for example, that when the contrast experiment was tried in the presence of music, one or two degrees more of red appeared in our results, we should hardly be justified in concluding that music tended to heighten the effect of color contrast. One or two degrees are too small in comparison with the probable error of measurement. But should our results regularly run up twenty or twenty-five degrees whenever the music was heard, we might justly feel some premonitory emotions of discovery. Or to take a case actually tried, we do find that when a sharp line is drawn between the green and the gray the results show such a falling off in the amount of apparent red that it is impossible to attribute it to an error of observation; we are sure that it is a psychological effect produced in some way by the line. In spite of the roughness and error of the measurement here, we may unhesitatingly conclude that the effect of the green upon the gray is heightened by a certain lack of definition in the impressions themselves. Largely for this reason, contrast tints in the landscape are best seen through half-closed eyes.

Importance of knowing the range of error.

Valid inferences from results that contain error.

This seems to me to break the force of the objection based on the inexactness of the laboratory experiments. No measurements, whether they be psychic or physical, are exact beyond a certain point, and the art of using them consists largely in checks and counter-checks, and in knowing how far the measurement is reliable and where the doubtful zone begins. And all this is quite possible in the case of psychological research.

Objection that all psychological measurements are really physical

More acute and more difficult of answer is the objection that the laboratory work, exact or inexact, does not measure anything mental at all; that what is really measured in each case is some purely physical fact — the excitation in our nerves or even some process in the world outside our bodies. Serious as this objection at first appears, it need hardly, however, disconcert us.

certainly does not apply to time-measurements.

For, in the first place, we must except from any doubt of this kind the experiments on the duration of mental phenomena. If I look at my watch and see how long it takes me to run through a chain of ten associations starting say with Transvaal, Transvaal reminding me of Krueger, this the *Kriegerverein*, the Franco-Prussian War, Paris, the Revolution, Carlyle, the burning of his Manuscript, John Stuart Mill, the Logic, — this process, I find, takes perhaps ten seconds. The ten seconds here are the duration of the mental process, as nearly as I can measure it; and not primarily the time of some physical process, say that in the brain. The brain-process corresponding to this train of ten associations doubtless lasts

about the same time; but that is an inference once removed; the direct observation is of the time of the ideas and not of the operation in the nerves. The nervous action is a relatively hypothetical affair, and to time it I have to work back from my immediate measurement of the mental facts. The measurement here, then, is first and foremost a measurement of mental occurrences. And the same holds true, although perhaps less obviously, of the delicate time-measurements in thousandths of a second, of which some examples were given earlier. Similarly the experiments dealing with the spatial and numerical character of our mental processes are primarily mental measurements. Whatever physical quantities we get in this way are secondary matters, inferred from the results of the mental observations.

The intensive measurements look suspiciously physical.

But when we pass to the experiments on the intensity of psychic phenomena, there does seem to be something strange and suspicious. In the first place, if we are really making mental measurements, why are not our scale and our units of measurement mental in character? The standard or unit in every case seems to be a purely physical thing. In experiments on the sense of touch we may use a series of brass or cork weights, of grammes or milligrammes,—a physical quantity, out and out, and not psychical in the least. And in the case of color contrast the units of intensity may be so many degrees of a physical sector of red paper of a certain texture and hue. But how can a mental phenomenon be measured by a physical scale? As far as the strictly psychological processes are concerned, must not our results inevitably be as

wide of the mark as if we tried to express the effect of the Choral Symphony in horse-power or in foot-pounds?

The units of measurement here are really psychic.

A doubt of this kind is natural, and yet it is largely due to a misunderstanding of the real nature of the standards of measurement here. When we say that the reddish contrast amounts, in one instance, to 20°, and in another instance to 30° of red on our measuring wheel, we certainly do not mean that it is literally equivalent to a certain angle of a red paper sector. That would be absurd; the contrast effect is not an arc or an angle at all. The more pronounced red in our revolving measure-disk is, as we directly experience it, a purely *intensive* effect. For convenience' sake, we designate the different intensities by the angular measurement of the sector which produces them. But what we are really working with is a scale of intensive experiences. Our scale, or measure, is psychic, although we speak of the different points on the scale in physical terms.

And the same is true of experiments with weights, although not of all. We find, for example, that under one very definite set of conditions a person can just feel the difference between a weight of 100 grammes and one of 130 grammes; but if we slightly alter the conditions the same person can distinguish between a weight of 100 grammes and one of 103 grammes. We use here the language of physical weights, but in reality we are dealing with the sensations which the weights produce. We find that by regular gradations of pressure upon the skin we can, within certain limits, produce a graduated scale of sensations

running from a barely perceptible touch up to a degree of violence where touch is swallowed up in pain. This series of *sensations* is the real psychological scale, and the brass weights are the mere machinery for getting this before us. There is no ground here for the charge that our standards of measurement are physical and not mental.

But are these units fixed and invariable?

But as regards the intensity of mental phenomena (the department which, all along, has given the most trouble), there is an additional difficulty which for the honor of the work one might feel tempted to pass by. There is certainly something here that is quite different from our ordinary conception of measurement. It is said, no doubt libellously, that in the early Mexican surveys in California the measure employed was a thong of rawhide which stretched with use, and that this accounts for the progressive increase in the length of the blocks, at Santa Barbara, for instance, as one walks back from the shore. Now it is barely possible that there is something comparable to this in the psychological measurement of intensity. It is difficult to prove that in these experiments the unit of measurement remains absolutely the same throughout the whole stretch to be measured. For, to return to the illustration of color contrast, the measurement was in terms of a scale of color intensities, or saturations, produced by a regular series of enlargements of a red sector, and the results were stated in degrees of this sector. On the physical scale each division of the arc of red paper is exactly like its fellows, —the tenth or the twentieth step is the same as the

first. But we cannot be sure that this is the case in the series of mental intensities produced by the gradual enlargements of the sector. For aught we know each step in the mental scale may be different from its predecessors. All that can be confidently said is that the mental series is composed of a number of small additions, but we have no assurance that every addition which we call by the same name is really of the same amount.

No assurance of their constancy.

In fact, some have long felt that we have good experimental reason to believe that any scale of intensity in our laboratories, whether it be a series of reds such as has just been mentioned, or of pressure-sensations or of sound or temperature or pain, — that none of these scales is an ordinary arithmetical series where each member is as good as its neighbor, but that it is a gradually diminishing series in which each additional step carries us farther along, it is true, but not as much farther as did the one before. The thong here is supposed to shrink instead of stretch. There are others who believe, however (and they seem to me to have the better reason), that the different degrees or units of any given psychological scale are approximately uniform throughout. But this is still debatable ground, and the decision must be reached, if at all, by further patience and experimental sagacity. Until a solution is found our quantitative results in regard to intensity must give forth an uncertain sound.

This does not make the results valueless.

And yet, even before this defect shall have been made good, such measurements are by no means useless or without significance. In spite of their uncertainty they may serve as the basis for wide inductions. We

must simply avoid the obscure portion of our results and, as all scientists must do, base our inferences only on the portions that are sure. But it may not be out of place to repeat that the worst difficulties are confined to that single class of experiments which would measure the intensity of mental occurrences, and are not present in those dealing with the temporal or spatial or merely numerical quantity of the phenomena.

The purpose of measurements.

And now a word as to the purpose of these measurements. Suppose that the measurements *are* valid, one might ask, of what use are they? It has been claimed that there is a vast difference in the purpose of mental and of physical measurements; that physical measurements are for their own sake — are an end in themselves — whereas mental measurements are not. The truth is, that no sane person ever measures anything, whether it be physical or mental, just for the sake of measuring it. He measures in order to discover the interrelations of things. If the mensuration is not for some practical end, like that of fitting garments or of navigating the seas, it is for the higher utilities of intelligence — for the sake of understanding the relationships and laws in nature. We measure mental processes for a like purpose, to discover their connections and kinships. Psychology, like all the sciences, is earnestly concerned with laying bare the causes and circumstances of the various facts with which it deals, and since mensuration is of great assistance in attaining this result, one can well understand the interest a psychologist takes in

the general inquiry we have had before us in this chapter.

It is because the question of mental measurements is thus an important one for the laboratory work that so long a review has been made of the weightier objections to the quantitative method. One might feel tempted to say that something must be wrong where so many objections can be raised. There is no need, however, of drawing this conclusion. After all, as Cattell has said in regard to these difficulties,[1] objections can be raised to anything. In the present case the work is comparatively new, and seems to be more revolutionary than it really is; and withal a good deal of partisan feeling has been aroused both within and without, with a resultant tendency either to magnify or to belittle the whole thing. Undoubtedly a better understanding will come about in due season; and in the meantime the experimenters do not seem inclined to wait until the doubters are all silenced. The work goes merrily on, and the outlook is bright. The few examples already presented will perhaps enable one to see the general character of such experiments and the leverage they offer for prying into the recesses of the mind. In the later chapters there will be opportunity to become further acquainted with the practical uses of this quantitative work. Conclusion.

[1] Cattell, "Presidential Address" [on the history and value of experimental and quantitative work in Psychology], *Psychological Review*, March, 1896.

CHAPTER IV

THE EVIDENCE FOR UNCONSCIOUS IDEAS

The problem appeals to the emotions,

THE question of the existence of unconscious mental states is a difficult one to discuss with philosophic calm. Cold and abstract as psychology may appear, it has its own schisms and heresies, its own emotional problems, the answers to which determine whether one shall be numbered with the orthodox or with the wayward.

since it touches our most varied interests.

In the first place the recognition of unconscious ideas savors strongly, at the present time, of psychological *Aberglaube*, — of thought-transference, of spiritistic communications, and all that goes with the term "psychical research." Moreover, there seems to be an intimate connection between the doctrine of the unconscious and that of pessimism. The Oriental philosophies incline to both. Consciousness, according to most eastern thinkers, is the source of all evil, and blessed Nirvana is to be attained only by a return to the reality of life, which is unconscious. Amongst us such a view is expressed in Wagner's *Tristan und Isolde*, and is worked out in philosophic detail in the writings of Von Hartmann. Finally the doctrine seems to strike at the very roots of psychology itself. There has already been occasion to speak of the rôle which introspection plays in the study of

mind. All the work in psychology, whether it be physiological or comparative or experimental, rests ultimately, as was said, on the validity of this introspective method. But if we were once to admit the existence of mental processes which elude the keenest self-observation, it would appear that introspective evidence were no longer decisive and that there were room in psychology for all manner of vain guesswork and imagination. It seems to unsettle the foundations of the faith, and those who have at heart the interests of the work must ward off the thought in very self-defence. The notion of the unconscious is consequently a source of anxiety to the conservatives, and even to some who, like Professor William James, have a radical strain in them. To his mind, this doctrine is "the sovereign means for believing what one likes in psychology, and of turning what might become a science into a tumbling-ground for whimsies." [1]

Because of these wider connections of the question, it is well-nigh impossible to keep our judgment uninfluenced by our sympathies. Our warm blood compels us to have some preference as to where the truth should lie. Persons especially interested in the "borderland" of mind will, perhaps, find it difficult to tolerate a doubt as to unconscious phenomena; while those who have cast in their lot with a critical psychology, or who feel that the philosophy of the unconscious, with its accompanying pessimism, puts an end to morals and religion, will be apt to harden their hearts at the bare mention of the word.

[1] James, *The Principles of Psychology*, Vol. I, p. 163.

Perhaps none of us, then, may be unbiassed; and yet, for the very reason that the question does lead out into the deeper interests of life, we cannot afford to neglect it. We must review the evidences, and especially the experimental work, that bears upon the case.

The unconscious in psychology seems to many a self-contradiction.

Have we any reason to believe that there are aspects of experience of which we are not directly conscious? In regard to the physical world, it seems intelligible enough that there should be things that no one has ever seen — stars too dim to affect our sight, bits of matter too small for our microscopes to reach. But at first sight at least, it seems impossible that there should be anything analogous to this in the mental world. For does not the very essence of what is mental lie in its being consciously before us; are not its *esse* and its *percipi* identical? Lotze has asked us what a pain would be which nobody felt; and the absurdity which attaches to such orphaned sensations would appear to belong to any mental fact which nobody could observe. To many the unconscious has always seemed a self-contradictory notion, like a square circle or warm ice.

Leibnitz and the unconscious.

Yet in spite of the difficulties that beset such a conception, and of its mystic air, especially at the present day, it has had its sponsors among the most penetrating thinkers. It was originated, in fact, by Leibnitz, who certainly gives an impression of intellectual health and balance. The reader will recall in Carlyle's "Frederick" the remark of Queen Sophie Charlotte: "Leibnitz talked to me of the infinitely

little; *mon Dieu*, as if I did not know enough of that." This thought of the infinitely little, which is the kernel of his mathematical discovery of the infinitesimal calculus, was also given by him a psychological application. According to his view, there are infinite degrees of mental life, from clear and perfect intellect, through consciousness that is like a dream, down to that of creatures existing as in a swoon or dreamless sleep. And since each creature is the world in miniature, — a mirror of the universe, — and since each recapitulates the whole series of creatures below it, we find in each human mind a scale of mental gradations corresponding to the scale of creatures: clear thoughts, obscure and dreamy impressions, and finally those that lie below the level of consciousness, too faint and confused to be perceived. These last he calls "minute perceptions" — what we should perhaps designate as subconscious or subliminal ideas. To use his illustration, we hear in the distance the roar of the sea, produced by the sound of the separate waves. Each individual wave must produce in us some subconscious effect; for if the effect of each wave were zero, we could never account for the actual roar we hear. It cannot of course be made up of a number of zero quantities; it consequently must consist of a host of impressions exceedingly minute.[1]

Present-day evidence in its favor.

I shall not attempt to trace the history of this thought since Leibnitz's day. It was caught up and passed along to our modern psychology, where it has found lodgement even amongst many who give little

[1] Leibnitz, *Opera Philosophica*, ed. Erdmann, p. 197.

recognition to any save our sober, common mental phenomena. Nor can we well consider more than a few of the varied arguments by which this view is supported in our time. Those who ardently believe in unconscious mental operations find evidence for them in almost every act that we perform: in our instincts, in our habits, in the short-circuiting which takes place at times in association, as well as in the common operations of sense. But the main emphasis is laid on certain derangements of mind, particularly on those strange lapses of memory by which whole regions of a man's experience pass from view, accompanied as this often is by an equally strange return of long-forgotten portions of the past. In extreme cases this leads to the so-called mutations of personality, somewhat as Stevenson has portrayed them in his "Dr. Jekyll and Mr. Hyde." Such phenomena, in connection with similar facts that develop in the hypnotic state, are now made much of as testimony for a subconscious life. Cataclysms of this kind, it must be confessed, put psychology to the test; its present system seems hardly able to support such strange occurrences.

"Alterations of personality."

Evidence from memory.

And yet, if we could but rid ourselves of the blinding effect of custom, the commonest act of forgetting or of recollection would not seem one whit less mysterious than these other more striking phenomena. To say that the facts of double or of multipersonality are but morbid exaggerations of processes we perform every day, of course does not explain them, but it at least puts us in a position to see that, as far as the reality of an unconscious stratum of experience

is concerned, we can as well infer it from the one case as from the other. The fact that to-day I can recall experiences which had faded away during the night, and that in the dream state the mind of the most staid of us may drop its usual contents and live for hours in a mental whirl of dime-novel adventure, is just as good or bad evidence for unconscious ideas as the fact that Krafft-Ebing's poor patient Ilma S. could sing Magyar songs and secrete articles while in an abnormal state of mind, and know nothing of these acts until the same state was reinduced.[1]

What becomes of forgotten ideas?

Where were the experiences that they could completely disappear and yet be recalled when the hypnotic condition was resumed? Likewise we may ask, Where are our waking thoughts, our scruples of conscience, our pride and prejudice, that we can dismiss them in our dreams and yet find them awaiting us when we drop our play character and return to the serious concerns of life? In all these cases there is a lapse of ideas from consciousness, and yet, evidently, some kind of persistence of them since we again meet them at a later date. The readily suggested explanation is that in the interim these ideas, as ideas, continue their existence in some subconscious limbo where they await their recall.

Ideas are acts of ours, not substantial things.

Such a doctrine, however, appeals more strongly to the imagination than to the intellect. Ideas and experiences are not stable objects that can be laid away on our psychological shelf. They are processes, or *acts*, of the mind, and are as perishable as the acts

[1] Krafft-Ebing, *An Experimental Study in the Domain of Hypnotism*, tr. by Chaddock, New York, 1896, p. 59.

They may be reënacted, but are never literally preserved.

of the body. We can in either case perform the act again and again, and can add to it the further act of recognizing that it is something that we have done before. But it is as difficult to believe that the mental process, as mental process, can be stored up, as it would be to believe that the present movement of my arm is a reincarnation of the identical arm movement I performed an hour ago, which in the meantime had continued its existence in some intermediate state.

But may not this activity continue subconsciously?

But this might be said to beg the whole question. Granting that our ideas are not solid bodies that can be kept in storage, but are mental acts which exist only while they are being performed, may not the continued existence of a forgotten idea be conceived as an endurance, in some way, of the mental activity of which the idea consists? The survival of an idea in the subconscious state would thus be intelligible; it would be but the continuation, in a low degree, of the activity which in consciousness is clear and above board. The recollection of experiences would then be like the sudden brightening of a fire that had all the while been slumbering but not extinguished.

As a mere matter of conceivability perhaps no fatal objection could be raised to such a view. Buried in our experience there may be such smouldering coals. But what evidence have we that such is actually the fact?

The lack of evidence for this.

It is sometimes assumed that the recurrence of an idea is of itself sufficient evidence of this low persistent activity during forgetfulness;[1] that there must

[1] Cf., *e.g.*, Platner, *Philosophische Aphorismen*, ed. 1784, Vol. I, p. 103.

of necessity be this uninterrupted life of the idea to serve as a kind of bud out of which the full-blown idea may again develop in consciousness. But if we cling resolutely to the notion that ideas and memories are not things or organisms, then it is clear that the revival of a mental image no more presupposes the continuance of the selfsame idea in low intensity than the recurrence of the movement of my hand requires that during the time when the hand seems to be at rest it shall all the while be rehearsing in low degree the motion which is later to be performed in full. If a physical movement can recur after an absolute interruption, why may not a mental process?

The persistent influence of the past

At first there may seem to be an unanswerable objection to this view. If each of our thoughts, no matter how often recurring, is an absolutely new creation, and our former experiences do not really endure, how is it that these former experiences exert such a vital influence upon our present thoughts? As an actual fact, we find that the judgment we now make, the things that we desire, the scenes that we can imagine or recall, are moulded by the experiences of former days. Our whole outlook is colored by these past impressions and ideas. Does not this show that, whether we recall the past or not, we cannot sever ourselves from it, and that somewhere beyond the horizon of consciousness these thoughts and images must still exist and exert their influence even within the circle of our present ideas?

But such a theory does not in the least help us to understand the facts, but is rather a hindrance. In the case of the body there is a similar state of things

to be explained, and any argument like this one which is so alluring in the mental realm would seem sheer nonsense or mythology. For in our physical conduct we notice that our acts of yesterday influence our movements of to-day. In trying to swim, you find that it makes a difference whether you begin as a novice or have grown accustomed to the stroke. So the tricks of voice or of gait that we unconsciously imitated years ago, show unmistakably in our present physical behavior. But we should never think of ascribing this behavior to the literal presence of those older acts, forming some kind of unseen *aura* around us and exerting a living influence upon our present functions. We should say, rather, that the former acts themselves are dead and gone, and what remains is not even a pale image or copy of them, but that the person in enacting them formed a habit or disposition[1] by which such acts could as often as he pleased be reënacted, but never literally preserved.

does not imply the continuance of ideas.

What persists is the disposition to certain acts.

Something like this is certainly the simpler and more reasonable way to explain the apparent persistence of our ideas. Just how the "disposition" is to be understood would be a nice point to determine, and would take one far into the problem of the interconnection of brain and mind, and into that, also, of psychic and physical causation. It is possible that the disposition might be conceived as something purely physical, as a persistent neural arrangement. This, however, is not the only way to conceive of habit in a psychological sense. We might believe

Ways of conceiving such dispositions.

[1] Cf. Stout, *Analytical Psychology*, 1896, Vol. I, p. 21.

that the mind of itself is capable of regular behavior, and that it does not owe this solely to the brain. Each mental act that we perform may well start or strengthen a purely mental disposition or trick of behavior, or bring about a combination of simpler mental habits already formed. The disposition would then be of the nature of a very specialized mode of activity; it would mean that, given the suitable conditions, such and such special processes would follow. This mode itself, of course, would not be an unconscious idea or an imperceptible mental phenomenon in the sense we are now considering. These mental habits could persist through comparatively long periods of disuse. Or, on the other hand, the occasions which call any special tendency into operation might arise so rarely that the disposition itself would finally become obliterated. The conditions of memory and oblivion may thus be described in terms of mental tendency or mental habit running parallel to the neural tendency or neural habit by which we describe the brain side of the operation. And there are other forms of explanation should we wish to avoid even a tentative adherence to the doctrine that mind and body run parallel without any interaction whatever.

The argument from hypnotism falls with that from memory.

We may safely conclude, therefore, that neither the phenomenon of memory nor any other recurrence of ideas gives decisive evidence that there are acts of our own minds that we are unable to observe. And the argument from memory is really the kernel of the various arguments from hypnotism, alterations of personality, and the like. The only evidence for

unconscious ideas in any of these cases is that masses of ideas disappear and reappear, and as far as the logic of the case is concerned, it of course makes no difference whether the mass be great or small, important or unimportant. The alteration of large aggregations of ideas, such as occurs in serious disturbances of the mind, is therefore no more conclusive for subconscious mental events than are the facts of ordinary recall.

The evidence from automatic writing and speech.

The phenomena of automatic communication, however, might seem to put the matter in a different light. The facts here are akin to those of alternate personality already referred to, with the difference that the contrasting personalities are now present simultaneously and can express themselves through different channels at the same time. An acquaintance of mine (a highly intelligent, although somewhat neurasthenic, woman) could, while perfectly conscious, write automatically a fluent discourse that was often a surprise to her, in its contents, and even a shock to her sensibilities. Her hand seemed controlled by some independent mind. And Dr. Hodgson, reporting experiments on the ever-interesting Mrs. Piper, says that when "Phinuit" is using uninterruptedly the medium's voice, her hand may all the while be carrying on some active communication as from another personality,[1] reminding one of the story of Cæsar and his amanuenses. Flournoy's recently reported case of Hélène "Smith" exemplifies

[1] See the *Proceedings of the Society for Psychical Research*, Vol. XIII, pp. 293 *et seq.*

the same thing.[1] While oral communications were being given, ostensibly from Mars, Flournoy was often able to obtain from the medium's left index finger comments and suggestions claiming to be from a mundane person named Leopold, *alias* Cagliostro. Such cases as these are different from the ordinary phenomena of forgetfulness. Different personalities, each with characteristic tricks of thought, are present at the same time. The consciousness itself seems cleft, and the one side appears to be ignorant of the occurrences in the other.

The spiritistic *vs.* the psychological interpretation.

The spiritistic interpretation of these things would at once, of course, destroy their value as evidence for unconscious mental action. If "Leopold" be regarded as a distinct mind using Hélène's finger as a means of communication, Hélène's ignorance of his mental operations would not indicate that these processes were unconscious *for him*. It would simply be like our own ignorance of the present thoughts of the Emperor of Germany. But if we adopt the psychological point of view, and regard the various "personalities" in a case like Hélène's as but different forms of the activity of the one person, then we must acknowledge that in the end they may favor the doctrine of the unconscious; but since we are as yet ignorant of so many essential features in these abnormal phenomena, one may well hesitate to decide just what they do mean. We must wait for more light on the question whether the secondary personality's thoughts (if thoughts they be, and not some amazing

[1] *From India to the Planet Mars* (transl.), New York, 1900; cf. especially p. 120.

trick of the nervous system) are indeed unknown to the primary personality at the time when the expressive movements are taking place. For the most part we have to depend on the subsequent recollection of the person, and a negative result here is quite compatible with a dim consciousness of the other personality's thoughts during their actual occurrence. It may be as in our dreams, where a number of different personalities occupy the stage at the same time, each representing a different point of view, each ignorant of the next move of his fellows, and yet there is nothing strictly unconscious nor any absolute cleft in consciousness, for all the *dramatis personæ* are included in the larger single mind which is their theatre.[1] In Flournoy's report, it is extremely suggestive that when "Leopold" was presumably in exclusive possession of Hélène's senses and reactions, and remarks were dropped by persons in the circle that would have offended the medium, she apparently did not hear them, but, after the trance, she showed by her conduct for weeks that the slighting words had not been lost upon her.

Parallels from dream "personalities."

The more cautious position, then, would be to regard these cases as due to parallel and relatively disconnected streams of activity in the one mind. In all probability they are not beyond the range of self-

[1] A striking instance of this character occurred recently to a friend of mine. In a dream he was cross-examined as a witness in court. The counsel for the opposing side (by a series of questions narrated to me) gradually enticed him into a situation which ended in the witness's immense surprise and confusion. There was here no mere recollection of a past occurrence, but rather a creation of a relatively independent personality.

observation were the person in a condition favorable to introspection, or had he the training and interest needed for detecting the most obscure activities of his own mind.

Evidence from the threshold of sensation.

But passing from these abnormal phenomena, an entirely different line of evidence is suggested by what is known in modern psychology as the "threshold." An illustration will make clear the meaning of the term in this connection. If an ordinary telephone receiver and an electrically operated tuning-fork be suitably connected with a Du Bois-Reymond induction apparatus (Fig. 9), the telephone will repeat the low drone of the fork with varying degrees of loudness according to the distance between the two coils of the induction instrument. Beginning with a loud note, we can gradually diminish the intensity until we reach a point where the sound is just heard, and then, as we pass this point, the note is lost. The limit between our consciousness of the impression and its absolute imperceptibility is what is called the threshold, — a warm domestic word, for which some have proposed to substitute the cheerless term "limen." The threshold, then, is the border of consciousness in general, beyond which is outer darkness; and the illustration from the realm of sound is but a single case. Similar illustrations might be drawn from any of the senses, or even from our inner life of memory or imagination or feeling.

In the particular example just used, when the sound crosses the threshold it apparently ceases to exist psychologically. But however that may be, we know

The threshold seems to indicate imperceptible sensations.

that the physical stimulation — the vibration in the telephone — continues far below this point. Now many have thought that as the physical stimulation runs down a long scale of intensities below the point where the sound seems to die away, so, too, the psychic effect must likewise have a gamut of intensities below the threshold. In other words, the threshold here would be the point, not where the sound as a psychic phenomenon ceases to exist, but where it reaches an intensity too low for us to perceive it. Anywhere between the intensity of stimulation which we consciously perceive and an absolute zero of intensity there would be actual psychic effects of a subliminal or subconscious sort. This is practically Leibnitz's old argument from the roar of the sea reappearing in modern laboratory guise.

The analogy between brain and mind is here misapplied.

The argument, however, is clearly defective. When more closely examined the reasoning is found to be this: since mind and brain show so many analogies in their behavior, we may assume that the analogy continues throughout. Why may we not reasonably infer, then, that a nervous excitation which is too weak to be noticed is still accompanied by a dim psychic process — by an *unconscious* sensation? This would seem to be but a consistent development of the prevalent doctrine of a parallel between mental and nervous states. The difficulty, however, is that even if there should exist the closest analogy between the action of brain and mind, the fact of a subliminal stimulation would not in the least imply the existence of a subconscious experience. For we must remember that by the stimulus we mean the outer

physical irritant which plays upon the delicate organ of sense. The excitation, if it is to produce any psychic effect, must be strong enough to urge its way onward to the gray surface of the brain. If we knew that the subliminal vibrations of the tuning-fork really excited this particular region of the nervous system, then our parallelistic assumption would force us to admit that there must be some subliminal experience corresponding to this low degree of nervous action. But we do not know that the subliminal sound stimulates the brain at all. On the contrary, the tone may be imperceptible just because it is too weak to call forth a cerebral response. It cannot overcome the resistance along the way, and so its weak energy is dissipated. According to this view, the threshold of consciousness corresponds to the point where the brain itself ceases to act. There would thus be no subliminal brain-processes in this case at all, and consequently no ground for arguing the existence of subconscious sensations to correspond to them. For this reason the argument from the threshold and from the existence of subliminal stimuli, on which many persons from Leibnitz to Höffding have placed reliance, is after all unconvincing.[1]

[1] Cf. Höffding, *Outlines of Psychology*, tr. by Lowndes, pp. 71 *et seq.*

CHAPTER V

FURTHER CONSIDERATIONS AS TO THE UNCONSCIOUS

Further evidence not yet disposed of.

IT is an axiom of logic that the collapse of any number of arguments decides nothing as to the truth or falsity of the view they were intended to support. So that we may still ask whether Leibnitz's doctrine is correct, even though the evidence he offers be not decisive. When we carefully distinguish between Leibnitz's notion and the popular view of unconscious ideas, the essential features of his conception seem to me to have solid support in the facts. Even after rejecting the greater mass of the evidence, as we have done, there is a remnant that cannot be disposed of in this way.

Ideas are probably never unconscious.

But this evidence by no means indicates the existence of unconscious ideas as currently understood. Nor does it seem probable that Leibnitz intended anything of the kind. When he argues that, because the distant surf is heard, each wave must to some extent affect us mentally, this need not mean that a single wave would arouse in us a subconscious *idea of a wave*, — a picture of undulation and blowing spray, such as is called up when we hear the sound near by. Psychologically speaking, there is a vast difference between hearing the low sound produced by a distant breaker, and hearing it as a breaker. In the latter

case we not only catch the faint sound, but its full meaning. It means to us sea and sand and salt air, a particular curve and play of color — all of which is not auditory at all, but is merely suggested by the auditory impression. The *idea* of the wave is thus a highly organized affair, and there is little reason to believe that any such complicated mental process takes place beyond our immediate observation. But that there are relatively bare auditory impressions, stripped of all those associations which raise them to the dignity of an idea, — too faint perhaps to arouse their usual associates, certainly too faint to be distinguished against the vague background of other sensations, — that there are imperceptible occurrences like these, in the psychic realm, there seems to be good reason to believe. To call them unconscious ideas prejudices the case; they had better be termed imperceptible events or imperceptible phenomena.

But relatively bare sensations perhaps exist imperceptibly.

What seems to me satisfactory evidence of their existence comes from a large body of experiments which measure our accuracy of distinguishing impressions. In every kind of experience we find that there is a limit to our power of discerning differences. Two lights may be of different brilliancy, but if one of them be not at least $\frac{1}{160}$ brighter than the other, they seem to be the same. Two musical notes whose wave-rates do not differ at least a fifth of a vibration a second, seem to the most delicate ear to be of identical pitch. Similarly, odors or tastes or touch sensations, or any occurrences whatever, can be dis-

Evidence from experiments in discrimination.

tinguished only so long as the difference between the impressions is of a certain amount. There is a threshold here not unlike the one already considered, except that it marks the point, not where *sensations* disappear, but where a *difference* between them disappears, the sensations themselves remaining clear and prominent. We found that the existence of a subliminal stimulation was no evidence that there are subliminal sensations; what must we now say in regard to a difference which cannot be felt? Shall we say that an imperceptible difference in the mental field is not a difference at all; that the very backbone of a mental fact is the way it feels — its *esse* is its *sentiri;* and that there is no real difference between psychic phenomena until the difference itself is felt? No answer can be given offhand. It is quite conceivable that two different facts in the outer world — two weights, for instance, one of 100 grammes and another of 102 grammes — would produce in us identical experiences, identical feelings of touch. The difference might be lost somewhere in transit between hand and brain, or if it actually reached the brain, there might be no corresponding difference over on the mental side.

Imperceptible differences.

There is good evidence, however, that although we cannot perceive a distinction here, a mental difference really exists. If we compare 100 with 102 grammes, we find that they give absolutely indistinguishable intensities of pressure; so, too, if we compare 102 grammes with 104. If impressions that feel alike really are alike, then the first is identical with the second, and the second is identical with the third;

consequently, the first must be identical with the third. As a matter of fact, however, the first and third weights are under suitable conditions clearly distinguishable.[1] And from this we may assure ourselves that the sensations arising from 100 and 102 grammes are really different, although the difference is imperceptible. For if they were identical, they would behave alike; they would be either equally distinguishable or equally indistinguishable from 104, whereas they are not; we find that one can be distinguished from the pressure of 104 grammes, while the other cannot. The addition of 2 grammes to 100 is imperceptible, but it produces nevertheless a real alteration of the mental state. But of course such imperceptible gradations in experience are not confined to this single realm of touch. The same evidences and the same argument could be repeated in regard to a wide variety of experiences, — in regard

[1] Such small differences are clearly perceived when an immediate and instantaneous change is made from the lower to the higher weight (though not when passing in the reverse direction), after the manner described in my "Ueber die Wahrnehmung von Druckänderungen bei verschiedenen Geschwindigkeiten," *Philosophische Studien*, Vol. XII, p. 531. The average threshold for increase for 100 grammes was there found to be 2.5 grammes.

An additional illustration of a difference in sensations that is real but imperceptible could be found in the fact that the difference between two successive impressions becomes clear when we shorten up the time-interval between them, although with a longer interval the two impressions seem identical. The mere change of the interval cannot be supposed to *produce* the difference of intensity; it merely makes it apparent to us by allowing the comparison to be more exact. With the longer interval between the impressions, there is consequently a real difference that we cannot perceive.

to sight, hearing, temperature, pain, and the like. Unaided self-observation might lead one to acknowledge here only considerable differences without intermediate steps. But the experimental evidence goes to show that nature makes no leaps. In all these fields there are infinite gradations of intensity and also of quality that are real, although they entirely escape our observation. They are, to use Leibnitz's phrase, *petites perceptions*, of whose existence immediate introspection gives no hint. Such facts as these seem to me to compel us to admit that the mind is wider than the portions we can directly perceive. And the great advantage of such evidences as these is, that they do not require some questionable assumption such as that there is a complete analogy between mind and brain, or that stimulus and sensation run exactly parallel courses. All this is left an open question, and the decision of it either way does not affect the present evidence in the least.

No assumption here as to the relation of nervous to mental action.

From the position thus gained we may return to the question of subliminal sensations, and point out more clearly what the probabilities are.

The "absolute" and the "discriminative" thresholds are identical.

The reader will recall the two kinds of threshold mentioned some moments ago, — the threshold where a sensation fades completely away, and the threshold where two impressions, although clear and strong, cease to be distinguishable. It is customary in psychology to draw a sharp line between these two kinds of phenomena, and to say that the disappearance of a sensation is quite different from the fading out of a difference between two sensations. In all probability, however, this is a mistake, and the

two facts spring from the same source. The point at which a diminishing sensation seems to die away is probably not where its intensity becomes zero, but is merely the point at which it is no longer distinguishable from the nebulous background of sensations that are always with us. A particular impression must have a certain appreciable strength of its own to cause it to stand out from this dim confusion, arising in part from the mere circulation of the blood in the various organs of sense. The low murmur of life, as from a great city, is always within us, and a weak sensation may be lost from view merely because it is not sufficiently different from the host of other weak sensations present at the same time. As further experimental evidence which directly favors this view, we find by actual test that all sensations feel more and more alike the weaker they are. A person blindfolded cannot unerringly distinguish between the soft contact of wool and a gentle glow of warmth near the skin.[1] And careful observers will not infrequently be in doubt whether an exceedingly minute change of pressure on the skin is of sound or of touch.[2] It seems probable therefore that what we call the absolute threshold — where sensations seem to fade away — is but a special case of the general fact that differences must be of a certain amount before we

[1] See Moleschott's *Untersuchungen zur Naturlehre*, etc., Vol. VIII, p. 393, where Fick reports Wunderli's original experiments. His observations are readily verified.

[2] This I have found to be the case with several good subjects when a slight noise occurred at the moment when a barely perceptible change of pressure was expected. See "Ueber die Wahrnehmung," etc., *Philosophische Studien*, Vol. XII, p. 547.

can perceive them. A pressure or any other experience must possess some appreciable intensity if we are to recognize it in the chaos of other sensations so like it. As soon as we can no longer discern it we feel that it is gone, but in truth it may still exist through many degrees of strength before it utterly passes from the mind. The limit to our power of distinguishing differences, taken in connection with the general similarity of weak sensations, leads one consequently to believe that these simpler mental processes do actually descend to a low and dim region where introspection cannot follow them. They are subliminal, and yet they are still in the mind. Let their strength be still further reduced, and they cease even this shadowy life. The existence of subconscious sensations, which could not well be inferred from the fact of subliminal stimulations, thus appears quite reasonable when approached from the side of these imperceptible differences.

The existence of imperceptible sensations now seems better supported.

Direct evidence of their existence and force.

But if this were all, there would perhaps be a certain theoretical interest in the fact that experience could exist at so low an ebb, but we might be inclined to believe that the existence of imperceptible phenomena was of no importance for our mental life. The experimental work goes to show, however, that these obscure and even imperceptible variations are important factors in processes which we can perceive. They affect the action from behind the scenes. Our conscious space-perception, for instance, may be altered by these utterly elusive elements. Some recent experiments by Dunlap show that lines so drawn as to produce an illusion of distance, may influence our

Effect of unseen shadows.

estimate of space even when these lines are quite imperceptible.[1] In the Müller-Lyer diagram, shown in Fig. 10, the small angles on the horizontal line make the two halves seem of different length. In the experiment mentioned, such a horizontal line was

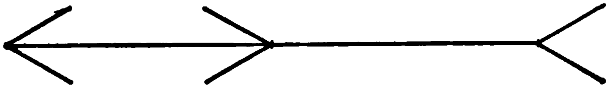


FIG. 10. — The Müller-Lyer figure.

distinctly visible with its segments marked by short cross-lines (Fig. 11); the small angles of the Müller-Lyer figure, however, were made by shadows from a light so faint that the observer could not tell whether

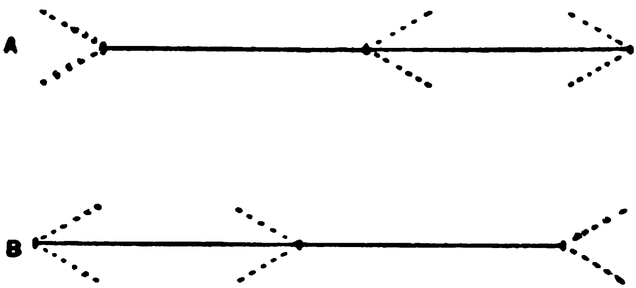


FIG. 11. — The dotted lines show the different arrangements of shadows that — even when they are invisible — continue to influence one's judgment.

the angles were thrown as in *A* or as in *B* of this figure, nor whether in fact any angles were thrown upon the line. And yet under these circumstances the run of judgments in a long series of experiments

[1] Dunlap, "The Effect of Imperceptible Shadows on the Judgment of Distance," *Psychological Review*, Vol. VII, p. 435.

indicated that the apparent length of the segments was altered according as these subliminal shadows were cast in the one way or the other, or (unknown to the observer) were not cast upon the line at all.

Experiments with inaudible sounds.

A further and final example might be drawn from the effect of sounds upon the attention. We have all had our attention caught by the sudden stopping of a clock, although we could not otherwise have told whether it had been ticking or not. It may be that in this case we are conscious of the beats, but are simply more attentive to other things. But under different conditions the facts seem somewhat less ambiguous. Suppose a person is in a silent room listening intently to a low sound in a telephone, growing fainter and fainter, after the manner already described (p. 79), until finally he is unable to hear it, strain his ears as he may. Yet even when the observer is positive that he has lost the sound, if the imperceptible note be cut off completely, the subject will often notice the change. A void suddenly opens up in the auditory field which had already appeared a perfect blank. At other times, when the subliminal sound is cut off, what we are struck by is not so much the disappearance of the sensation itself, but, rather, a sudden and subtle change of mood — a feeling of relief, as if the attention could now be honorably recalled, since the tenuous nothing for which it had been searching had been definitely reported dead. If this correctly describes the mental state, what we feel under these particular circumstances is not the departure of the sound itself, but a conscious effect of that departure, a sudden unaccountable relief. It

would imply that the sound, imperceptible though it was, could still muster up strength to tease and elude the attention, until the actual stopping of the sound brought the strain to an end. There is, of course, nothing decisive in this alone; it might be explained without assuming that the sound was there at all. For it is not always necessary to have a present experience of a thing in order to note its departure. Its mere physical presence may produce a condition of nervous equilibrium for which there is no positive psychic counterpart, while its sudden interruption might disturb this *status quo* sufficiently to give a slight but positive mental shock. But on the whole the explanation I have suggested seems to me the more probable, and so I offer the experiment as supporting the doctrine of imperceptible mental events.

Character of the evidence as a whole.

And as in this case, so I might say of all the evidence offered,— that alternative explanations are possible. Brain-processes or mental facts may yet be discovered which would put all our evidence in another light. And to entertain even the possibility of other explanations has a certain value; it serves as an encourager of hesitancy, and brings one to his senses who would claim that he can demonstrate the case. He may flout the alternatives as he pleases; but if there is an alternative even of the most improbable sort, he must change his tone from absolute proof to preference and probability. So that the facts I have presented are given with the feeling that they are gently persuasive merely; they invite rather than compel our belief.

Concluding interpretation of the results.

What seems to me the meaning of these evidences is perhaps already clear. They lead us to a mean between two indefensible extremes. On the one side is the teaching that all the events in the mind occur in full light, and that the natural history of the mind must confine itself to those occurrences which a trained introspection can report. Experimental results, however, draw us away from such a view; they show us that it cramps the facts. At the same time they do not carry us to the opposite extreme — that of unconscious ideas as so often understood. That is a mystic doctrine according to which we each have an unvisited psychological lumber room (to use Mr. Podmore's expression), with its accumulation of forgotten experiences, a room which, though unvisited by our conscious self, is occupied by an unconscious self, busied with all manner of unconscious devices to accomplish unconscious ends: getting subliminal pleasures and disappointments out of its quiet, subliminal life. Here the unconscious mental life is conceived as filled with much the same kind of things as is our conscious life, the difference being that it is unconscious. Our researches lead us into no such extravagance as this. The results are not in favor of unconscious ideas, but rather of certain unconscious materials out of which conscious ideas arise. They lead us to acknowledge that there are indiscernible occurrences in the mind of a very definite and non-mythical character, comings and goings of dim sensations, subtle variations in the strength and quality of certain constituents, which, minute and imperceptible though they be, are sufficient to destroy the equilibrium and

produce a transformation of the whole mental state. The experiments, though they carry us to no extremes, do open up a new and most attractive field of research. They assure us that we can go a little below the surface, a little into the shadows of our experience.

No danger to psychology from the unconscious

And now a word as to James's indictment[1] that all this is the "sovereign means for believing what one likes in psychology, and of turning what might become a science into a tumbling-ground for whimsies." One must acknowledge that there is a certain historical justification for James's remark. The doctrine of imperceptible phenomena to-day keeps bad company; it seems to have an affinity for minds that throw logic and the canons of induction to the winds. But we must beware of psychological exclusiveness, and not reject a truth because we feel aversion toward the kind of men who most readily accept it. And, after all, there is nothing more anarchic in this doctrine than in the notion that the physical world has its imperceptible events. What a tumbling-ground for whimsies the recognition of an invisible energy like electricity or magnetism has supplied! Only some weeks ago a deluded mortal was expounding to me how insanity could be drawn off from one person and injected into another by means of magnets. But one does not on this account feel that scientific procedure is at an end, once we admit what leads to such vagaries. Dreaming and knowing are as distinct after such admissions as be-

[1] See p. 67. Professor James in his subsequent work has become more friendly to the unconscious. Cf. *e.g.* his *Varieties of Religious Experience*, 1902, pp. 233 *et seq.*

provided the scientific attitude in regard to the evidence be maintained.

fore. Because *immediate* sensible confirmation is dispensed with, we need not think that all the ordinary rules of evidence are abrogated and that we are free to believe what we please. There must still be sensible evidence for whatever is proposed in this field; but since the evidence must now be circumstantial, rather than direct, all the more need of putting it mercilessly to the test, of holding before ourselves alternative explanations, of weighing and sifting until we can convince ourselves that there is more reason to believe that some unseen factor is at work than that the causes of the phenomena are among the events we can observe. Neither credulity nor hardened unbelief will serve us here; we must demand the evidences, but respect them when they come. Such an attitude seems hardly to endanger the progress of psychology, but rather gives an added assurance that the study will progress.

CHAPTER VI

ILLUSIONS AND THEIR SIGNIFICANCE

Illusions are of peculiar service to the psychologist.

OUR illusions of perception seem contrived for the special purposes of psychology, — as if Providence, foreseeing the natural perplexity of the student of mind, had sent them for his comfort. For nothing else reveals as they do the manner of the mind's activity. As long as our mental operation is perfect, and does not color or distort the facts, the mind is like some subtle medium that permits us to see all things, while remaining itself unseen. But when once the mind's action becomes troubled so that it tinges and deforms the scene, then our psychic processes themselves come to view and we are enabled to note their form. For psychological purposes, therefore, illusions might perhaps be compared to the delicate, artificial stains which are of such help to those who use the microscope; the dyes discolor the object and render it in a way untrue; but only to bring out with tenfold clearness the hidden niceties of its structure.

For this reason the study of illusions occupies a prominent place in psychological work. Whatever may be one's field of investigation, he must constantly attend to the illusions there; and not with a purely negative and hostile attitude toward them, as might

perhaps be supposed — as if an experimenter wished to find them only in order to avoid them and free his results from error; but rather does he welcome them as of positive service in throwing light on the problem in hand.

Their range and provisional classification.

It is difficult to find a field of research where these distortions of reality do not occur. Our sense-perceptions — taste, touch, hearing, sight — are proverbially fallible. But they are by no means alone in this. Self-observation, also, gives us appearances opposed to the facts; there are errors in our estimate of time; and memory inserts into the past various items that never occurred, or transposes the order of actual events. So that one is embarrassed by the very wealth of the materials here, and is forced to make an unusually exclusive selection to illustrate the more significant features of the subject.

For the purpose in hand it will perhaps be best not to group illusions, as is frequently done, according to the special field in which they occur, as illusions of sight or of touch or of introspection or of memory; but according to the general causes which produce them. Judged by the broader circumstances under which they arise, there are three provisional classes into which illusions may be grouped.

I. Illusions from spontaneous sensations.

In the first class we should include those illusions which arise from a certain perversity of the sense-organs in that they give us sensations by spontaneous action, not waiting for an excitation to come in from the outer world. Such is that subjective ringing in the ears which we sometimes hear, and perhaps also the faint mist which our eyes always give us even

FIG. 12. — Apparatus for producing an after-image of motion, in direction the reverse of the original movement.

when in the darkest room, although this may be in large part due to an action of the brain. The visual field is never free from vague forms and colors not due to outer things — forms which persist in our sleep, and doubtless furnish much of the stuff our dreams are made of. In the case of the delirious and the insane, such images are possibly more intense, and when decked out by the morbid fancy, become the strange realities which people their world.

Into this class fall also many of our illusory contrast effects and complementary after-images. In the eye, the stimulus falling on a particular place of the retina produces a temporary disturbance of the functions of neighboring parts; and even after it has ceased to play upon the nervous surface of the eye, some time is required before a perfect equilibrium is again restored. This is perhaps the cause of that illusion of motion we get after looking at a spiral like the accompanying one (Fig. 12), made to revolve at a moderate speed; when the spiral is stopped it seems gradually to draw in or expand — there is a viscid flow in a direction opposed to the original movement that the spiral seemed to have as the figure revolved. The same thing occurs if we look over the side of a moving ship at the water rushing by; the deck will then seem to glide slowly toward the bow of the vessel, or if we look long at a waterfall and then away to the cliffs, these move gradually skyward. It seems clear that all these illusions depend in the main on some disturbance in the sense-organ, an unusual behavior of the eyes or ears in these cases is at the bottom of the abnormal experience.

Let us now pass to some examples of illusions which offer a certain contrast to those we have just been considering.

II. Illusions from stress of attention.

If two equal weights — each, say, 50 grammes — be concealed in boxes of quite different size, the weight in the large box will seem, when lifted, much lighter than that in the smaller box. And the amount of the illusory effect can be measured; we may gradually add to the weight in the larger box or take from that in the smaller one, until the two seem equal; the addition or subtraction thus required to bring them to apparent equality gives us some idea of the strength of the illusion. In the case of boxes having the relative sizes given in the diagram (Fig. 13), I have often found that the weight of the smaller box must be reduced by as much as 15 grammes before it will seem equal in weight to the 50 grammes having the larger volume. The illusion starts from the expectation which the sizes of the boxes arouse. Experience has taught us that in general the weights of things increase with their volume. But the actual weight of the larger box is so much less than we anticipated, and so much less than we had prepared our hand to raise, that by contrast it seems much lighter than it otherwise would. It is underestimated, and for like reasons the weight in the smaller box is overestimated.

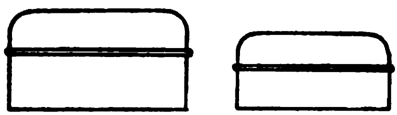


FIG. 13.

A further illusion of similar psychological import is found in comparing the intensities of a number of

sounds coming in quick succession. When we listen to such a rapid series, say of clicks that are of equal strength, if they come neither too fast nor too slow, most persons cannot actually hear them as equal. Certain regularly recurring members seem slightly more emphatic than the rest, and the whole series falls into a subjective rhythm. We can interrupt this periodic emphasis and make it rest now here, now there, but fall somewhere it must; the attention must glide over some beats and linger on others, and this subjective selection somehow tricks us into a momentary feeling that the favored impressions are the stronger.

Under other circumstances the stress of attention, as is well known, deceives us in our estimate of time. A stretch of blank time marked off by an initial and a final stroke does not seem of the same length as an identical interval filled in with a number of successive strokes. It will seem longer or shorter than the "filled" time, according to the actual length of the time with which we are dealing. But still more striking is the illusion which may occur as to the order in which impressions come. If we observe a rapid sequence of colors appearing at an opening in a screen, and a stroke of a bell be given in conjunction with some single one of them, say, green, the place in the color series where the stroke seems to occur is usually not its true place in the series. We ordinarily locate the sound much too early in the series; it will seem to come, perhaps, with a blue or a yellow that preceded the green. Why we should do this is not entirely clear; the displacement is too

large to be accounted for by the lag in the photochemical process of the eye, so that the illusion is probably due to the unequal attention we give to the different members of the series. Our greater attention to the sound seems to crowd aside the colors which appear at about the same time; the stress upon the bell stroke gives it a prominence and temporal promotion over some of the colors, which for an instant are less attended to and consequently suffer a kind of eclipse.

These are not explained by "experience."

Phenomena of this kind do not spring from the sense-organs, nor can they be fully explained by appealing to habit or custom or "experience." Experience has not taught us that in the majority of cases sounds come early in a color series, or that successive sounds really are due to causes which show a rhythmic rise and fall of energy; nor has experience taught us that large bodies are usually lighter than small ones, but more often the reverse. These illusions, therefore, reveal a mental activity to some extent independent of mere custom brought about by experience; they show that our mental processes interplay and modify one another — that our estimate of time, for instance, or our feeling of the intensity of a pressure or a sound is neither imposed upon us by sheer force of the outer facts; nor is it, on the other hand, the result of a special and isolated psychic process whose only function is to mark the time or to perceive weight or sound. Men used to believe in a number of independent activities of mind. We had many separate faculties working like separate organs in the body, — a faculty of sight,

They show the interplay of mental processes.

another of touch, of memory, of judgment, of attention, and so on, — a view well represented in the old phrenology, where a special brain-tract was given over to the exclusive use of each of a score of psychic activities, from smell to "philoprogenitiveness" and reverence. Illusions show, on the contrary, how closely interlaced, how interdependent, our mental activities are; the errors spring from an intimate interplay of sensation and memory and attention and judgment. Our mental stress, our attention, our feeling of value, can cause the temporal order to be reversed; there is, then, no sense of time in which attention and interest play no part. The weight-size illusion also shows how the different sides of mind conspire: expectation and images called up from previous experience here crowd in upon the actual sensations, but instead of being able to make these sensations appear like themselves, they make them take on an entirely contrasting aspect. And the same occurs in the rhythm of equal sounds; the intensity is affected by our subjective attitude toward them; they are caught up and impressed by the general state of the mind. No sensation has an inviolate inner character which remains unaffected by the larger mental life. The connection, the significance of impressions alters their very essence. The quality of the voice sounds different when we cannot understand what is said; and colors in the face or in the landscape come out with surprising freshness if we see them reflected in a distorting glass or metal, or look at the scene with head bent, so that the recognition of objects is in some degree disturbed. The

Even sensations take their character from their mental setting.

meaning of sensations changes their pure sensation quality. Each process is what it is because other things are what they are; here, too, nothing is fair or good alone. The fiction of independent sensations which by association make up our perceptions and ideas, the fiction of a number of separate faculties each with its exclusive field, — these go the way of the similar fictions in physics or political science, — the belief in a world constituted of independent atoms, or in a sovereign state arising by contract of free and independent persons.

III. Illusions due to fixity of interpretation, or "custom."

The final group of illusions would include, perhaps, the great mass of our familiar deceptive experiences: the change in the apparent distance of objects from us as the atmosphere changes in clearness, the vivid appearance of depth which the stereoscope gives, the circling of things about us when we are dizzy, the car-window illusion which makes our train seem to be in motion when a train beside us begins to move — all these and a hundred more have a certain common origin. These illusions, unlike the group just considered, *are* due to mental habit or custom, are due to the particular training which experience has given us; and, having once learned our lesson, we proceed to apply it with mechanical regularity, in season and out of season. We stick to the mode of mental activity which we have found appropriate to the general run of cases. Thus ninety-nine times out of a hundred we find that the movement of the whole field of view from a car window is due to the motion of the car itself; the habit of interpreting this expe-

FIG. 14. — Aristotle's Illusion.

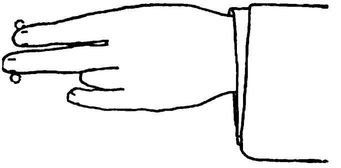


FIG. 15. — Diagram to represent the psychological effect of the contacts in Fig. 14.

FIG. 17. — The converse of Aristotle's Illusion. First form.

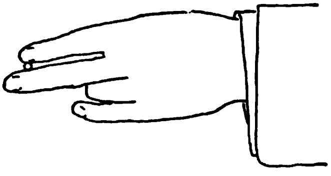


FIG. 18. — Diagram of the psychological effect of the contacts in Fig. 17.

FIG. 19. — The converse of Aristotle's Illusion. Second form.

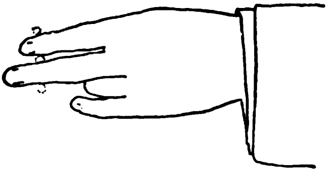


FIG. 20. — Diagram of the psychological effect of the contacts in Fig. 19.

rience becomes fixed, and thenceforth all movements of the whole field mean for us but this one thing, whether they actually arise from our movement or not. If the more usual way in travelling had been to sit still at a window and have something move the landscape outside until the right portion of the earth arrived, our illusion would have been the reverse; an actual motion of the car would then have felt like a movement of things outside our window.

Aristotle's illusion and its converse.

An excellent example of illusions of this class, and one, moreover, which permits of experimental variation and reversal, is the familiar deception of touch, called Aristotle's illusion. If the index and second finger of the same hand be crossed and a pencil be placed between their tips, as in Fig. 14, we feel two pencils there instead of one. Here, again, the cause is found to lie in long training and mental habit. The parts of our fingers with which the pencil is in contact can usually be touched only by two separate objects with the two fingers lying between. The tactile impressions, being such as are customarily caused by two objects, are by force of habit interpreted as two (somewhat as in Fig. 15), although a single object is now the cause.

It is especially interesting that the converse of this illusion is also true; namely, that an impression which is habitually due to a single object will be felt as a single object, even when, from the unnatural position of the fingers, it is now produced by two objects quite a distance apart. If two prongs of flexible wood or of wire be attached to a handle so that they can be manipulated together (Fig. 16), and they be so

adjusted that the crossed fingers lie between them and yet in contact with them both, as in Fig. 17, places on the skin can now be found which absolutely destroy the feeling of distance between the prongs; they merge into one, and are felt as a thin strip running up between the crossed fingers (Fig. 18).

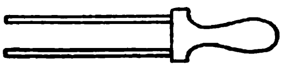


FIG. 16.

Or again, if we move the two prongs to points on the skin which normally require three separate things to touch them at once, as in Fig. 19, the two strips are now felt as three (Fig. 20). The single principle holds throughout this varied illusion, that we interpret the impressions according to the causes which normally produce them. The sensations which usually come from a single object are felt as a single object: the impressions which usually come from two objects are felt as two objects, however these impressions or sensations may, under exceptional circumstances, be produced. In this entire class of illusions, therefore, there is clearly present a process of *interpretation*, and the mode of interpretation which we adopt for all cases is that which experience has taught us is generally correct. The illusions themselves arise because of exceptional cases not provided for in our general rule of interpretation. By sheer mental inertia we continue to interpret the exceptional cases as if they were regular, and so we go astray.

Light on normal perception.

Nothing could better illustrate the way our minds work, not only under exceptional circumstances, but also under ordinary conditions. Our illusions make clear the process of perception itself; they show

how we perceive the outer world even when we perceive it correctly. We do not stand face to face with the outer facts and passively receive their accurate image. There is no direct and absolutely reliable intuition of things without. The world merely gives us a succession of impressions which of themselves have no single and inevitable meaning. Our sensations are more or less arbitrary symbols of the outer facts, and we must learn to read them. To use Berkeley's figure, our sense-impressions are a language; and, like any language, they must be gradually learned and are never entirely free from misunderstanding. Many of the signs are of doubtful meaning, and we must judge them as best we can. Here, of course, training, our previous experience, our temporary preoccupation, the immediate surroundings or context, are what determine what we shall feel to be true in the particular case. But nature at times runs counter to all our expectations. She uses a familiar expression in an unusual sense, and finds us totally unprepared. It is much as if some laborer, busied in a watch factory, were suddenly to rise to poetry and sing the praises of the spring; his expression "spring" would produce on the minds of his stolid fellow-artisans an effect analogous to our illusions of experience. Their own particular world would be too much with them, so that this rare and unaccustomed application of their term would be misunderstood.

The outer world speaks a language

with, occasionally, an unusual turn of expression.

Now, in spite of these various sources of illusion — the perversity of the organs of sensation, the inter-

play of our several mental processes, and the interpretation of exceptional experiences according to a habit to which the general course of experience has trained us, — can we bring all these different causes under one common principle?

The more important illusions are clearly due to errors of interpretation. They are not justly to be called errors of sense; the sensations are not at fault, nor has the organ of sense perverted the facts. The symbols or signs of external reality have simply been misunderstood. Here the illusions, we might say, are of intellectual rather than of sensory character; if we could arrive at their right meaning, no illusion would occur. But in two of the classes of deception, the symbols themselves do not seem to be misinterpreted; they have been distorted, in the one case by the nervous organism, and in the other by our mental stress. These illusions consequently seem to stand in a group opposed to the others.

The three groups of illusions are fundamentally alike.

And yet when we come to examine them closely, we can see that there is no fundamental difference here. Even the illusions that seem most clearly due to sense are actually from a higher source; and if there were no error made in interpreting the impressions, the mere impressions themselves, whatever might be their character, could never produce illusion. Taken by themselves, they are sensations, neither true nor false; they become true or false only when we begin to view them as signs of a more permanent reality. If we could keep from doing this, if we could keep from interpreting them, or if,

All involve a misinterpretation.

on the other hand, we could see them in every case in their proper relations, no illusions would occur.

The difficulty is that in themselves our sensations tell us nothing of their origin; they stand dumb before us and leave us to guess their secret. But since in the special senses more of the sensory impressions come from external than from internal causes, we find that it practically works best to fall into the habit of treating them all as from without. We take the course which suits the majority of cases, and so here, again, the illusion, even when it belongs to the class most intimately connected with the organs of sense, is at bottom due to custom or habit.

Conceivable worlds where illusions would be impossible.

We can conceive of two kinds of worlds in which no illusions would occur. The one would be a world in which every impression of a particular sort arose from one set of causes and only one. Here there would be no ambiguity, and each occurrence would be read aright. It would be like a language in which every word was always used in an unchanging sense. The other equally illusionless world, if world it might be called, would be one where similar impressions came so rarely from the same causes, that no habit of interpretation could ever be formed. Alice's *Wonderland* gives some hint of what such a state would be. Each experience would feel like an absolutely unique event; it would never indicate what was to come next; no expectation would be aroused, and consequently there could be no mistakes.

In this world we must learn to detect the errors.

But in our actual world, a mixture as it is of order and anomaly, illusions seem unavoidable. If we could confine our mental life to bare sensations and

their sensory associations (as some have erroneously believed we always do), if we could stop taking our sensations as indications of something more important behind them, there never would be any appearance contrary to reality. The oyster, the jellyfish, are probably under few illusions. But since we have developed to that condition where we are no longer satisfied with our surface impressions, but must always be asking what they *mean*, our hope lies not in less, but in more and better interpretations of them, in discerning truth and falsehood, in detecting illusions when they come.

How are they to be distinguished from true perceptions?

And so we must now consider the problem of distinguishing illusions from true perceptions. What is the psychological difference between them, and how can we detect an illusion when it arises? I have already pointed out the similarity of illusions and perceptions. In no case do we have an immediate, face-to-face acquaintance with the world; on the contrary, we must interpret and arrange as best we can the mass of impressions which constantly arise. We inevitably form some judgment of what they signify. So far the processes of illusion and of perception are alike; they are both estimates of what the sensations stand for.

Is the difference a purely logical one?

What is the difference between them? One feels tempted to say, with Sully, that the difference may be described as a logical one — perception being a kind of correct reasoning from the data or premisses, while illusions are fallacious inferences.[1] Much can

[1] See Sully, *Illusions: A Psychological Study*, 4th ed., p. 335.

be said in favor of such a view. There is a remarkable similarity between perceiving a thing correctly and drawing a valid conclusion from given premisses. Our perception of a man, for example, might be cast into the following syllogistic form: —

Major Premiss: All sensations having such and such definite characteristics are signs that a man is before me.

Minor Premiss: Here is a group of sensations answering this description.

Conclusion: Therefore they indicate the presence of a man.

This is in faultless logical form, and we might say corresponds to a true perception.

Strictly, both perception and illusion are fallacies,

But one becomes less confident that he can find in the logical character of the act the difference between true and false perception when he tries to cast an illusion also into syllogistic form. Suppose one of us to be laboring under an hallucination that a man is before us when in reality none is there. Expanded, the mental process might be stated thus: —

Major Premiss: All sensations having such and such definite characteristics are signs that a man is before me.

Minor Premiss: Here is a group of sensations answering this description.

Conclusion: Therefore they indicate the presence of a man —

the very statement which served to represent the correct perception. The mental process is as logically consistent in the one case as in the other; consequently, so far as valid form is concerned, illusion and perception are absolutely indistinguishable.

The truth is, of course, that while the conclusion here in both cases is correctly drawn from the premisses, the major premiss is by no means universally true. We are not justified in asserting that the certain definite characteristics referred to in our major premiss are the infallible sign that a man is present, since experience actually gives instances where this is not the case. The major premiss is false in both syllogisms, so that we have what the logicians call a material fallacy in every case of perception as well as of illusion. Or if we escape the material fallacy by rearranging our premisses to read: —

Major: Every real man gives me an impression of a certain definite character.

Minor: Here is something which gives me such an impression.

Conclusion: It must be a man —

then the premisses are sound enough, but we have the fallacy of "undistributed middle," recognizable immediately when we say, —

All gold glitters.
This thing glitters.
Therefore, it is gold.

and are indistinguishable by logic. And since the correct perception takes this fallacious form quite as readily as does the illusion, we are not aided in the least toward an accurate statement of the difference between the two.

But a flaw in the reasons we give for a proposition of course determines nothing as to its truth or falsity. We give bad reasons for many truths. In building up our experience from sense-impressions, then, we

fly in the face of formal logic. We jump at the truth from insufficient evidence. In other words, we take our chances, having found out by practical life that the risk of error is relatively small.

But if logic cannot help us to distinguish true experience from deception, since both are condemned by the rigid canons of deduction, how can we distinguish them?

Can illusions be recognized by going directly to reality?

A ready answer would be that our perceptions accord with the facts, while our illusions do not. According to this view, the processes themselves are not different; we could never by an inner analysis of the mental act determine whether it was an illusion any more than we could take a photograph of an unknown person and decide by chemical analysis whether it was a good likeness or not. We must go outside the mental process and compare it with external reality; then, and then only, have we any assurance as to its truth.

This would require us to get outside our minds.

This test of illusion is intellectually satisfactory only up to a certain point. For on closer examination we find that it is a test which none of us can use; it is, as the Arabs say, a gift of almonds to the toothless. The outer reality would be a serviceable criterion of illusion if we could be at once within our minds and outside them, so as to compare our own mental pictures with the facts as they really are. But we cannot escape our own mental bounds. The idea we make of the external world is not obtained by some immediate and unerring intuition; it is a laborious construction of ours out of our individual sense-

perceptions. To get at the reality by which we are to determine the accuracy of our perceptions, we have to depend upon the very images and processes whose veracity is open to question. Out of our sensory images — a mixture of perceptions and illusions — we have to decide as best we can what the real world is. It would seem, then, that instead of being able to test illusions by our knowledge of reality, we must first be able to sift out the illusions themselves from our truthful perceptions before we can say with decision what the real world is.

Experience involves a sophistic knot

For one who would be satisfied with no test which is not at once convenient and infallible, the case must be pronounced hopeless. Experience in this regard always reveals a curious instance of working in a circle: we cannot be certain what the real world is without distinguishing illusions from perceptions; we cannot distinguish illusions from perceptions without first determining what the real world is. Here is a pretty tangle that would have rejoiced an ancient sophist.

which we proceed to cut.

In practical life, however, we never stop to untie the knot; we cut it. We simply put our trust in the general run of experiences, and with them as standard we decide the worth of any particular case. Our practical test, consequently, is whether the special interpretation we have given our sensory impressions accords with the general system of our experience. If past experience is not sufficient to

Experience is used to check experience.

decide the case, I may immediately get additional experience to see whether it supports or condemns the interpretation I have made. If the tactile im-

pressions at my finger tips of the one hand suggest that two pencils are touching me, and yet the pencil as I grasp it with my other hand gives the clear impression of but a single object, I lose faith in the first interpretation; and if sight, moreover, assures me that but a single pencil is there, I reject the early impression as illusory. But if, when any of us put a single pencil between our crossed fingers, the double tactual impression were confirmed by the great body of our experience — if we not only felt two pencils between the two crossed fingers, but also felt two with our other hand, receiving besides a visual impression of them both, and had henceforth all the quiet satisfaction that comes from possessing two, being able to use up, lend, or mislay one, and still have the other; and if, moreover, our present experience accorded with our memories of past experiences, and was confirmed by the testimony and behavior of other persons, then we should all regard this as a valid perception and no illusion at all. Our only way of recognizing an illusion is by the fact that sooner or later it breaks with the body of our perceptions; one of our other senses, or the same sense under different conditions, does not confirm it, or it is confirmed by all the senses for a while only. Dreams are illusions of an elaborate kind, and hold together marvellously. So long as all the parts do hold together, there is no knowing whether we are dreaming or awake. But after a while the bubble bursts; the dream forms disappear as things in real life never do, an influx of law-abiding experiences occurs, fitting into the still larger system of memo-

Illusions are inconsistent with the general system of experience.

ries and associations, and in comparison with these the dream group immediately seems fantastic and unreal.

It is clear, therefore, that we do not go outside our minds to detect illusions; we have no immediate view of reality by which we may decide their truth. The experiences themselves are employed to judge one another. For most of us there is a stable mass of perceptions which offers a good practical criterion in any questionable case. But there are unfortunates whose experience does not allow so ready a discrimination. In the insane, the figures of imagination form such abiding and consistent groups, they occur in such orderly array, that, in time, the usual tests of reality fail. Their hallucinations show so many of the marks of reality, that the patient is finally at a loss to tell what is real and what is not. Or if he still have power to make this distinction, the effort of attention which this requires becomes too great, he gives up the struggle, and finally allows fact and fancy to mingle in wild confusion.

This test fails in the insane.

The relation of any given item to our whole experience, consequently, determines whether it is real. It is not sufficient that the experience have a basis in sensation, as is sometimes said. Our illusions usually have in them sensations enough; what they lack is harmony with the whole. They are discordant elements that refuse to clasp hands with the rest of our world, and so are adjudged unreal.[1]

And yet, in strictness, even our illusions are not

[1] As regards the view that the supreme test of reality is a *social* one, cf. p. 157.

unreal. Our dreams are real *dreams;* hallucinations are real hallucinations. So that, even in these cases, we are face to face with a fact of the world and not with a nonentity. And for this reason, even our deceptions must in some way belong to that harmonious system of experience which I have tried to show is our final test of what is real. We may speak as if they were rejected because they would not accord with the system. This, however, we may now see is only a convenient half truth. If our illusions were not somehow in harmony with the whole, our scientific faith leads us to believe that they would never occur. The discord arises because we try to put them in the wrong part of the system. They have a proper place; they belong among our personal and mental acts, and not in the physical world; and rightly understood they harmonize beautifully with the general character of experience. For the psychologist, they fit perfectly into the mental system; they are among its interesting realities. He scrutinizes them, he measures and times them, and many he can explain. Pure unrealities, of course, could not be dealt with thus.

Seen aright, even illusions harmonize with the system.

A healthy mind will, consequently, find in illusion no ground for discouragement. From time immemorial, the errors of sense have been pointed to as a proof of the unreliability of our powers. How can we be sure of anything, when our simplest faculties, our processes which come closest to external reality, are so deceptive? But this is only one side of the case. There is also the other side, that we not only have illusions, but we know that we have them; and

They do not justify distrust of the mind.

the power of detecting them ought to give us quite as much ground for congratulation and self-confidence as the illusions themselves do for distrust. If it were not for the general soundness of our life, we should never be aware that anything was amiss. So that no doctrine of total intellectual depravity can ever be supported by appeal to the deceptions of sense. They are rather an evidence that in the perceptual life, as elsewhere, there is a mingling of good and evil, of true and false. And since experience shows that along with the errors comes also the power of correction, knowledge is in the ascendant, and the future is secure.

Development need not free us from them.

Shall we conclude, then, that a more perfect mental adjustment will free us from illusions? It might seem from what was said earlier that such would be the case. If illusions spring from misinterpretation, — spring not from our sensations, but from the way we mentally supplement our sensations, — it would seem that when once we knew the truth the illusions would be dispelled. As a fact, however, many illusions will not down even when we know

FIG. 21. — Münsterberg's figure (slightly modified).

their character. Even after we know, for instance, that the contiguous edges of the squares in Münsterberg's figure (Fig. 21) run parallel to the lines *ab* and *cd*, the appearance remains contrary to this knowledge. And we may measure with compasses and

convince ourselves that the lower of the concentric arcs above the horizontals in Fig. 22 is the continuation of the curve below the lines, and yet the upper persistently appears to have this character; and so with a host of other illusions. The fact that

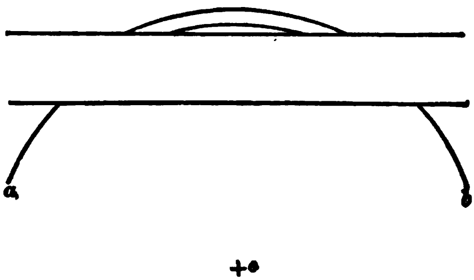


FIG. 22. — The lower of the arcs above the horizontal is the continuation of the curves *a* and *b*. (Verified by measuring from the centre *c*.)

further knowledge does not destroy their sensible force demonstrates how complicated the mind is, and what inconsistencies it can harbor. Our modes of interconnecting and interpreting our sensations are due to deep-seated mental habits, lying beyond the immediate control of our will, and even to a large extent beyond the influence of logical evidence. They have become ingrained through the hard schooling of years and, possibly, of generations. The judgment from the evidence, however, — our knowledge of what the unperceived facts behind the illusions are, — lies on the surface, and does not penetrate into the deeper mental constitution. Illusion is consequently compatible with perfect knowledge; and a higher mental plane would assure us only of the power to see through all deceptions,

Illusion is compatible with perfect knowledge,

but would be no guarantee that the illusions themselves would disappear. They would simply lose their power to mislead us; they would not be *delusions*, nor would they in any wise obscure our practical and moral relations. As soon as we are able to see around or through an illusion, it is no longer a hindrance, no longer a handicap, and consequently the process of natural selection or of adaptation to the environment cannot be depended upon to eradicate it. In fact, we may go farther than to say that illusions will continue because there is no especial need of our ridding ourselves of them, or that they will remain by inertia, for want of an opposing force. There is a positive utility of a higher kind in certain illusions. Judged by the standards of biology, they are defects; they are signs of an imperfect adaptation of the mind to its environment. But this is only half the truth. They are deficiencies that leave us the richer. For, having discovered that they exist, mankind makes them of service in that half-practical world of play and art. How much of the fascination of picture and of drama depends upon the light veil of illusion that floats over the whole, so fine that we at once see it and see through it. We have here the curious pleasure of being deceived and yet a party to the fraud. If the deception were perfect, it would be mere trickery; and yet, too, if there were no deception, we should lose some subtle charm. If illusions, then, are to be described in prosaic scientific terms as cases of defective adaptation, may the defect in some faint form continue in this life and in the world to come!

and may have a positive value.

In concluding, let us recall the main teaching of illusions in regard to the character of the mind. They show the interplay of the different sides of consciousness. Attention influences judgment, and expectation affects sensation. There are no sharp borders here. The usual divisions we make in psychology are not divisions in the facts themselves; there are no functions which act in isolation and without mutual dependence. Illusions, then, bring home to us the organic unity of the mind; they make it evident that the various sides are in constant sympathy and interaction, and that to some extent each participates in all that is done.

The main teaching of illusions.

Mentally, all things conspire.

But the more specific teaching is as to the manner in which experience is constructed. Illusions, when understood, are the most striking refutation of the common belief that experience is a kind of direct impress of external nature, we being passive recipients of the facts as the world imprints them upon our senses. There is a passage in the *Theætetus* which sounds odd enough to our modern ears, but which seems to be a foreshadowing of the truth. From the outer object, Plato tells us,[1] there comes an image toward the eye; and out from the eye there flows sight to meet the object. The union of these two somehow produces our actual perception of the thing. Curious as we may account this early psychology, it expresses the truth that experience arises by a union of two different factors — something which comes from the outer world, and something which we ourselves contribute from our inner store. The outer

Refutation of the *tabula rasa* doctrine.

[1] *Theætetus*, Steph., 156.

impression alone, according to Plato, is not enough; we must do our part; we must meet the impressions halfway. The outgoing sight darting from the eye to meet the image coming from the object, seems to represent what we now call our subjective elaboration of the incoming impressions — represents the associations or suggestions which these impressions arouse, —the form or arrangement into which we force them, and without which the bare sensations would have no meaning whatever.

Experience implies incessant activity on our part.

So long as our contribution to the experience — the associations, the suggestions, the "form" — is in perfect keeping with the outer facts, we might well believe that external nature itself was the sole and efficient cause of our panorama of the world, that we had really received the experience bodily from the objects themselves. But the frequency of deceptive experiences, of perceptions contrary to fact, makes us see that this cannot be; that we ourselves are all the while a chief source of experience. Deprived of the outer world, we should indeed be without the crude materials of experience; but the finished product, the real vision of nature and of history, depends quite as much upon us. The world, then, is beheld by us only indirectly, as we reconstruct it out of our sensations. Like the Lady of Shalott, each of us views the gay pageant of life as in a glass, and even this reflected image comes to us only as we keep to our task. Once we cease our activity, once we stop our weaving, at that instant — as in the poem — the glass breaks, the vision vanishes, and around us lies but the tangled web of meaningless impressions. The chief psycho-

logical significance of illusions, then, is to bring out the fact that the mind, even in what appears its most passive moments, is in ceaseless activity, and that its various powers of intellect and feeling and will constantly interplay. These illusions thus force us to the paradox that our very deceptions are an important instrument of knowledge.

CHAPTER VII

EXPERIMENTS ON MENTAL SPACE, PARTICULARLY THE SPACE OF THE BLIND

Kant and the psychology of space.

THE various questions connected with our perception of space were given by Kant a dignity that they had not before possessed. Locke and Berkeley had already made the subject inviting, but Kant brought it to the front as one of the crucial problems in regard to mind. Our view on this subject, he showed, would to a large extent indicate what our belief as to the validity and range of human knowledge in general should be. Under the influence of Kant's doctrine that our perception of space is somehow on a different mental level from our perception of light or of sound, and that it indicates the possession of mental powers transcending the impressions of the moment, the psychology of space became a thing of flesh and blood, and has ever since remained so. Against Kant are the British ranks from Hume to Spencer, maintaining that there is nothing anomalous here, nothing that points to peculiar or transcendent powers; it is all a matter of sensations and their association.

Interest aroused by modern geometry.

The interest which the psychology of space has derived from these contentions has been recently stimulated from an unexpected quarter. The dispute as to the character of our space-experience has broken out in mathematics. Many now believe that

what had been so long accepted as demonstrable in regard to space — for example, that the interior angles of a plane triangle are equal to two right angles — is, after all, but characteristic of the particular space with which we are familiar, and that there is at least the possibility of other kinds of space whose properties would not accord with the principles of the older mathematics. Out of such speculations has developed the modern non-Euclidean geometry.

The work of the laboratory, and of the experimenters outside the laboratory, — of the surgeons, for instance, who have contributed so much to our knowledge here, — is in sight of these interesting questions; but they must remain in the background until the details of the experimental studies have been brought more clearly before us.

The marvel of the mind's action here.

We all have an instinctive feeling that our mind reaches out into our very skin, and is in the actual presence of the objects that touch us. Sight also seems to bring us face to face with the world, as if we looked out at it directly through the pupil of the eye. But the more prosaic, and yet, after all, more wonderful fact is that the mind receives only indirect reports of what is going on without. The cortex of the brain, with which our consciousness is connected, lies in darkness, deep in its coatings of tough membrane and skull and flesh, and connected with the outer world only through the medium of long and delicate fibres that bring in messages from the outposts of sense. It is as if a person were secluded in an inner chamber and learned of the out-

side world only by an inconceivably elaborate system of wires and signals. From some difference in the signals accompanying the different messages, or from some peculiarity either of the tone or of the interconnection of the messages themselves, we are able to picture the scene which is causing the influx of sensations. The mind must distinguish the various impressions from different parts of the skin, or from the innumerable points on the surface of the eye, and refer each to its proper place in the external world. When one considers the complexity of the task, — that we can accurately tell not only the direction but also the ever changing distance from which sensations come through the rods and cones of the eyes, — the ease and security with which this amazing performance is accomplished is one of the marvels of life.

The limit of its power

Experiment shows, however, that there is a limit even to this power. When impressions come from points too close together we are at last unable to keep them apart. In the case of sight this limit is very low: fine lines, side by side, become confused and indistinguishable when the distance between them makes an angle in vision of less than about 60″. Stars in the heavens cannot be seen as separate when they are closer together than 30″. Under more favorable conditions, however, we can distinguish positions that are as close together as 7″ of arc, or about $\frac{1}{500}$ of a degree. When, for instance, two lines are placed end to end, and one of them is shifted slightly to one side, as in the diagram (Fig. 23), while still remaining parallel with the other, a dis-

FIG. 23.

placement of $\frac{1}{8}$ of an inch can be detected at a distance of about 400 feet.[1] This means that in the minute image at the back of the eye, differences of locality amounting to but $\frac{1}{50000}$ of an inch still give distinguishable impressions! Touch, while not so delicate as this, is also capable of exceedingly fine perceptions. An elevation of but $\frac{1}{8000}$ of an inch above a smooth surface is noticed by rubbing the finger tips over it.[2] But in experiments where we have to tell whether we are being touched by one or by two points, even at the finger tips we can scarcely distinguish impressions that are $\frac{1}{20}$ of an inch apart; and on our backs we often confuse sensations that are separated as much as two inches.

seems not to be fixed by the sense-organs.

Our first thought might be that the limit in all these cases is fixed by anatomical conditions; that the different impressions when they come too close together run on to the same sensory terminals, and thus become confused. But the minimum is more variable and often much smaller than it would be if due to a limit in the supply of nerve endings. In the case of touch, a few days' practice in feeling compass-points will reduce the threshold to a small fraction of what it was; and reduce it not alone at the part of the skin where the practice has been given, but at other parts as well. We can hardly believe that the

[1] Cf. "A New Determination of the Minimum Visibile," etc., in the *Psychological Review* for September, 1900 (Vol. VII, p. 429), and also in the *Compte Rendu des Séances, IV*ᵉ *Congrès International de Psychologie*, Paris, 1901, p. 411. Cf. Bourdon, "L'acuité stéréoscopique," *Revue Philosophique*, January, 1900.

[2] Brown, "Notes on a New Form of Æsthesiometer," *Journal of Physiology*, Vol. 27, p. 85.

supply of nerves is correspondingly altered at such short notice. And in vision our discrimination seems about four times as fine as it ought to be, if the merely anatomical measurements of the rods and cones in the eye determined its limit.[1]

How this is possible.

Any full explanation of this curious phenomenon would take one far into technicalities; but perhaps some assistance in clearing up the paradox that localization is finer than nerve differences may be had from keeping in mind that even the finest impressions never come from a single isolated nerve terminal in the eye, and probably do not in the skin. This is shown in vision by the well-known phenomena of irradiation and of contrast, which prove that even the smallest ray of light stimulates not alone the part of the eye on which it directly falls, but also the neighboring regions, as by some subtle sympathy between the different parts of the retina. The nervous elements thus respond always in groups and never singly. So that the space-signal by which the place of origin of a sensation is designated is not some simple sign comparable to the single numeral which drops down in our electric signal boxes when the bell rings, but must be a number of simultaneous signals, where the peculiar grouping tells much more than any one of them could tell alone.

Simile of a signal system.

Imagine an electric signal-box where the room in the house from which each signal came was denoted not by a single falling numeral, but by the simultaneous flashing of a great number of lights in the box, and this was moreover so delicately constructed that each light passed through

[1] See the "New Determination," etc., cited just before.

various gradations of intensity, or changed its color according as the person giving the signal was nearer or farther from the button that controlled the signal. In that case any one would have sufficient data to know not only the room from which the signal issued, but could, according to his training and mother-wit, determine up to any degree of exactness the particular spot in the room where the person who gave the signal stood. The limit of the number of wires in the house and the distance apart of their terminals would in this case not limit the exactness of the localization of the summons. The local signs with us seem, from the experimental evidence, to be of this complicated order — endless changes and rearrangements in the impressions coming from joints and tendons and muscles and skin and retina. The conscious discrimination of place, therefore, is a high order of mental achievement — not mere rote-work nor rule-of-thumb action, by any means. No two places, however close together, can give exactly the same combination of sensations; there will inevitably be some difference in their relative intensities or qualities. But there is a limit to our power of following these infinite gradations and combinations, and in this, rather than in the distance apart of the nerve terminals in the eye or in the skin, must we look for the causes that determine the spatial threshold.

The mental signs of locality.

Thus far it has been tacitly assumed that our acquaintance with space comes through both touch and sight independently. But psychologists are divided into parties on this very question. First, there

Which is the spatial sense *par excellence?*

are the tactualists, as we might call them, who believe that touch (including our muscular impressions) is the spatial sense *par excellence*, and that sight alone cannot acquaint us with the size or shape or distance or direction of things. On the other hand, there are the visualists, who maintain that sight is the only sense that gives us a knowledge of these things; that touch is a mere time-sense and gives us no feeling of space whatever. And finally, there are some who hold that touch and sight perform this work in common; that each of them is capable of space-perception, and that we consequently cannot attribute this to either of the senses as its peculiar and exclusive function.

The partisans of touch.

The question is an old one. The classic query of Molyneux to Locke as to whether a man born blind who had become familiar with a cube and sphere by touch could, if suddenly given sight, correctly distinguish and name each of these by vision alone, shows the problem in its early form. For if touch and sight had space as their common feature, we should expect that a person who had become acquainted with a form by one of these senses would immediately recognize it when this same form appeared to the other sense. Locke believed that such a recognition would not be possible; and Berkeley's "New Theory of Vision," going much more thoroughly into the underlying psychology of the question, arrives at a conclusion [1] quite in agreement with Locke. Berkeley was, in fact, the first to develop systematically the notion that vision, in its primitive purity,

[1] See p. 5.

lacks all space-character, and that it gets this only indirectly by association with tactile impressions. By long association, he believed, sight comes to suggest tactual experiences which are spatial, and consequently comes to suggest space, although the visual experiences themselves are spaceless; just as the odor of brass might suggest weight and resistance without the olfactory sensations themselves having weight and resistance.

Experiments after operation for congenital cataract.

The most striking evidence on this question comes from experiments on persons born blind, and given relief comparatively late in life by surgical aid. In a number of such cases, after the patient had to some extent recovered from the operation, he was allowed to look at objects already familiar by feeling, and was asked to name them. From Cheselden's famous case down, the testimony is fairly uniform that the patient cannot recognize objects by sight alone. He must first touch the thing or he fails to identify it. But once he has learned how the felt thing looks, thereafter the sight of it suffices for its recognition. Cheselden's patient, on seeing a familiar cat, could not tell what it was. Home's patient thought that a number of square and oblong cards were round; while Raehlmann's patient, when shown a large bottle, said it might be a horse. And when one of the surgeons twitted him on not knowing the difference between the two, he replied sheepishly that it was not so easy after all.[1] The young gentleman operated on

Usually, familiar objects are unrecognized by sight.

[1] For the more detailed references and a discussion of these cases and of those cited below, cf. "The Spatial Harmony of Touch and Sight," *Mind*, October, 1899.

by Franz, however, was the most intelligent and best educated of them all; and he was able, by very close attention, to distinguish a square, a circle, and a triangle; but he afterward confessed that the character of the figures did not become clear to him until he seemed to feel them with his finger tips. Then, although he was not actually touching them, he recognized the forms immediately. And again, in pointing out which of two lines was horizontal and which was vertical, he first carried his finger cautiously to the wrong one, and then corrected himself. Trinchinetti's little boy and girl grasped at things as if they expected to find them in the neighborhood of their eyes. So, too, Dufour's patient, when asked to take hold of a door-knob which he seemed to see, groped around for it like one in the dark. Rarely in these persons does sight seem to have been, at first, of much assistance in guiding their movements; in fact, one of the patients, even weeks after the operation, could hardly be induced to take a practical interest in what his eyes revealed. He would neglect the reports of sight, and fall back persistently into his old world of tactile clews.

The results seem to favor the tactualists' view.

Such observations are made much of as evidence that sight in its virgin state gives us no idea of space whatever. For, if the things of sight were really spatial, it is argued, why did these patients find the visual world such an unfamiliar land? Even though the sense-materials were entirely novel, the old *forms*, it would seem, ought to be recognizable if there were actually a common element of space in the two kinds of experience. Do not the experiments, therefore, show that Berkeley was right, and that until associa-

FIG. 24. — A negative of Fig. 25.

tions have had time to develop, touch and sight have absolutely nothing in common?

Possibility of a different interpretation.

It does not seem to me that they mean this. To show that they can well be interpreted in another way will require a somewhat long discussion; but the subject is so interesting and so important that a careful weighing of the evidence may not seem out of place. The evidence against there being any underlying similarity between touch and sight is, as has been seen, based largely upon the failure to recognize by sight objects known by touch.

Difficulties of vision after surgical operation.

But in the first place it must be remembered that a person is at a great disadvantage immediately after a surgical operation on his eyes. There are often pain and tears, and at best the eyes are not well under control. A lack of proper accommodation and co-operation of the two eyes must make the impressions which they give far from clear. But if, for this reason, one sees men as trees walking, his experience is nevertheless quite as spatial as if he sees them as men. The difficulty may be largely in telling where one thing leaves off and another begins; so that object and surroundings and background are poorly discriminated. Mere vagueness of impression is doubtless partly the cause of the defective recognition. But vagueness of objects is by no means equivalent to absence of extension. In gloom or mist we often fail to identify things, and yet they are certainly spatial.

Recognition depends on much besides spatial form.

But even disregarding this, the fact is that in our usual recognition of things we depend comparatively little on their pure space-form. Take so simple an instance as that of the tin cup which Johann Ruben,

in Raehlmann's account, could not tell by sight. Many would perhaps say that we appreciate that such an object is a cup by the shape of the thing, and that nothing else about it is of great importance. But imagine yourself searching for a tin cup in the dark and suddenly laying your hand on something the shape of a cup but made of ice or butter; the chances are that none of us would take it for a cup at all. What we should mark would be the damp, slippery feeling of the thing, and these would be so prominent that the form would pass unnoticed.

Reasons for overlooking mere shape.

Now it could quite as well be urged that touch here gave us no sense of form because we might not discern the shape of the icy or buttery thing, as that the newly attained sight gives no sense of shape because these patients fail to recognize objects by their shape. In their case the visual sense-filling of the object is infinitely novel and unexpected, infinitely removed from the familiar temperature and hardness and resistance in which the shapes of things had hitherto been embodied. The color, the glitter, the shadows around and upon each object, are something for which touch offers no counterpart whatever. And these unexpected properties are so absorbing, so baffling, that the abstract space-quality, the bare geometric character of the thing, fails to come to the front. The other aspects crowd forward and leave no interest for these more hidden marks.

Recognition may be hindered even when the form is unchanged.

The fact that recognition may be seriously interrupted even when the space-relations of objects are undisturbed may be brought out in other ways. What an unfamiliar look there is, to the unpractised

FIG. 25.

eye, in the photographic negative of even a well-known picture (Fig. 24). How many things in it escape us that are noticed instantly when light and shade are given their accustomed value (Fig. 25). Here the abstract space-relations are certainly left intact; the form, the outlines, are the same in the negative as in the positive, but the mere variation of the chiaroscuro hinders us in singling them out, and, for that reason alone, many of the details of the picture are as good as lost. Or if instead of changing the light and shade we merely invert a familiar scene, the recognition of forms is again perceptibly hindered (Fig. 26). If recognition flowed from the abstract geometrical character of the experience, it ought to occur as well after inversion as before. The inversion does not affect the shape or the interrelation of things in the scene, and yet the details are for some reason much less readily disengaged and identified. If, moreover, not merely a part of the visual experience, as in this case, but all things about one were inverted, it is remarkable how many things in plain view would be overlooked. Under these circumstances one may not know his next-door neighbor, and his home village may seem as strange as a foreign land.

How much more, when we pass to an absolutely new sense!

These examples have been multiplied to show that our recognition of objects depends upon many factors, and that the objects may appear strange to us even when their abstract form is all the while what we have been accustomed to. The mere resetting of the old form makes it unknown.[1] And yet the resetting

[1] An interesting case from a totally different realm, where recognition would at first sight appear to be *aided* by novelty of setting, occurs

in the illustrations just given is as nothing compared with the reappearance of tactual shapes in visual materials never before experienced. The sifting out of the common elements in two kinds of experience so closely akin as upright and inverted vision, or as a positive and negative arrangement of light and shade, must be the merest child's play in comparison with the perplexities of one just attaining sight. The very difficulty in analyzing the new experience, in selecting points of attack, and in discerning what is significant and what is not, in the endless confusion of light and shade and color — this would certainly account for the failure of those surgically operated upon to recognize familiar objects by sight alone.

The argument that sight originally is non-spatial thus falls.

The main argument for the non-spatial character of vision thus falls to the ground. For the failure to recognize familiar things by the newly attained vision, which is the main evidence adduced, can well be explained in other ways.

Evidence from Franz's case.

And this conclusion that sight is a space-sense is supported by the results of Franz's experiments already referred to. The case he reports makes it clear that if the patient is clever enough; if he has the requisite intelligence and training, he can recognize, albeit with difficulty, simple forms like a tri-

in the Indians' recognition of music. I once heard the late Professor Fillmore say that while among the Omahas he found that only when he introduced the harmonic "parts" did they recognize their songs when played on the piano. They failed to recognize them when played as simple melodies, although they themselves did not sing in parts, but in unison. But may it not be that the instrumental harmonies, in some subtle way, better imitated the chorus, and for this reason helped the recognition?

FIG. 26.

angle, a square, or a circle, even at first sight. His patient's remark that these figures were not identified until he noticed how they would feel in his finger-tips, is no evidence that the object as perceived by sight is from the beginning unlike its tactual counterpart. For, if the two experiences were not alike, how could the sight of the figure have suggested to his finger tips how it would feel before he had actually touched it? The suggestion here seems to have been clearly based on an underlying similarity in the impressions.

But which part of vision is spatial?

But even when we have reached the conclusion that sight gives us spatial impressions, the old problem is still present, although on a reduced scale. For vision itself is a compound sense. It gives us an intimate mingling of two very different kinds of sensations: the one kind being pure impressions of light and color, arising from the action of the nervous coating at the back of the eye, the retina; while the other kind are sensations of touch and strain, coming from the various muscles both within and without the eye-ball, and from the tactile surfaces of the ball, socket, and lids. It would, indeed, be difficult to show that impressions of light and color alone, without the aid of these tactile and motor accompaniments of vision, would have spatial form in their own right. With regard to this, no crucial experiment has ever been made.

Importance of the tactile-muscular element in vision.

On the other hand there is plenty of evidence that in our fully developed vision these motor accompaniments play a very important rôle. A partial paralysis of certain muscles of the eyes makes one incapable

of judging correctly the position of things; the difficulty of moving the eyes to one side, for instance, makes objects seem to lie much farther on that side than they really are. Not only this sense of the direction of objects, but also our feeling of their distance from us is largely due to the feeling of movement and strain in the eyes, and not simply to sensations of light and color. In regard to distance this is well demonstrated by the pseudoscope, an instrument contrived to reverse these motor sensations just spoken of, by practically transposing the eyes, so that the right eye acts as if it lay to the left of the left eye. In looking at things through this instrument (one of whose forms,[1] made with two mirrors, is shown in diagram in Fig. 27) the eyes have to converge more for farther objects and less for nearer ones — just the reverse of our normal eye movements; and as a result the perspective of the scene is, under favorable conditions, turned inside out. Far becomes near, convex becomes concave, and instead of an object concealing what is behind it, it cuts its own outline out of objects that seem nearer the observer, and is seen through them.

Shown by the "pseudoscope"

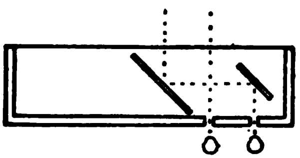


FIG. 27. — Pseudoscope (one form).

A slight change of this instrument gives what is called a "telestereoscope," which has an effect as if the eyes were suddenly placed abnormally far apart

and the "telestereoscope."

[1] Cf. "A Mirror Pseudoscope and the Limit of Visible Depth," *Psychological Review*, Vol. V, p. 632, and also in the *Scientific American*, Dec. 10, 1898.

— carries them, as it were, to *a* and *c* in Fig. 28, in contrast with their real position at *a* and *b*. It thus intensifies the eye movements as we look at different portions of the scene, and as a result strangely increases the usual depth effect. The perspective appears pulled out, accordion-like, to surprising lengths. These experiments show that the relief which objects have in the foreground of vision — the vivid plastic effect which the familiar stereoscope so well reproduces — is utterly wanting to beings whose vision has mingled with it no sensations of muscular movement and friction coming from the coöperation of the two eyes. Many fish and birds, consequently, while having two eyes, but without any overlapping and conflict of the fields of view of the two eyes, must lack this plastic element in their visual experience. Such vision can give only indirect suggestions of distance like that offered in a skilful painting, but never our unique impression of binocular depth.

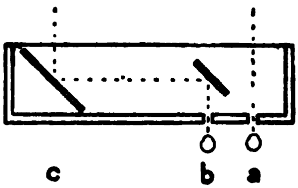


FIG. 28. — Telestereoscope (one form).

To this extent, therefore, we must acknowledge that visual space is dependent on touch and muscular movement. But granting that our most vivid and accurate perception of distance and of direction is due to sensations which are not purely of light or color, we need not go to the extreme of maintaining that distance and direction cannot be given by light and color at all. The inner nervous coating of the eye — the retina — seems to resemble the skin in its

The retina is a space-organ in its own right.

power to give a vague feeling of outwardness and of place, without the aid of the other senses. When a surgeon transplants a portion of the skin, for some time after the operation things touching this transplanted surface seem to be in contact with the body in the region where this portion or skin used to be.

Effect of displacing portions of it.

The similarity of the space-function of the retina is suggested by the occurrence of a like phenomenon in vision. Wundt has related that a disease of the underlying tissues in one of his eyes caused portions of the retina to shift their place. The scene itself seemed to suffer distortion in consequence. Objects were localized as if they were stimulating the place in the eye to which these nervous elements had hitherto belonged, and all things were seen awry, until the dislocated parts came finally to act as if they had always belonged in their new positions.[1]

As regards the importance of movement, then, the retina seems to be like the palm of the hand. Just as the hand, even when merely resting upon an object, obtains a vague sense of the relative direction of its different parts, and yet its movement brings out their positions more definitely and permits us more accurately to interconnect them and to cover a larger area; so with the eye. Its mobility gives a nicety and range of space-perception that a motionless retina could never attain. But the movements only intensify and perfect what would be there in some degree without them.

Much more briefly must we consider the evidence

[1] Wundt, "Zur Theorie der räumlichen Gesichtswahrnehmungen," *Philosophische Studien*, Vol. XIV, p. 1.

for what I have called the visualists' position. The supporters of this view would agree with all that has just been said as to the power of sight to make us acquainted with space at first hand, but would maintain that it is the only sense that has this power. Touch and movement, they hold, can of themselves give no feeling of space; those who have never seen, who have been born blind, live in a world that is for them, devoid of extension, — a pure time-world. This doctrine in fact gains its adherents chiefly among persons particularly interested in the life of the blind. Platner, for instance, in the eighteenth century adopted this strange view; and within recent years Dunan reports that a number of French officials in charge of institutions for the blind are convinced that one who has never seen has absolutely no sense of space.[1] Platner has been quoted as if his testimony were well-nigh decisive. But he had, in truth, no very exceptional opportunities for studying the problem, and offers practically no evidence whatever. He does little more than to assert somewhat impressively that for three weeks he investigated the case of a blind man and convinced himself that the blind know nothing of space. Dunan, on the other hand, does offer evidence, but it is evidence which after all does not make for his conclusion. He shows, for instance, that a blind man does not think of a distant object in the same way that a normal person does; that the perspective element must of necessity be

The visualists' position: sight is the exclusive space-sense.

Accordingly, the blind are thought to live in a mere time-world.

[1] Platner, *Philosophische Aphorismen*, ed. 1793–1800, Vol. I, pp. 440 *et seq.;* Dunan, "L'espace visuel et l'espace tactile, Observations sur des aveugles," *Revue Philosophique*, Vol. XXV, pp. 357 *et seq.*

wanting, for this is a matter entirely of sight. What we so prominently associate with distance, — the diminishing size, the converging lines, the loss of detail, the change of color, — all this must be absent from the blind man's picture of what is remote. But even so, we cannot conclude with Dunan that this implies that such a person has no idea whatever of distance. The essential thing is not that their representation should be identical with ours and should have exactly the same associations, but that there should be any appreciation of distance at all. With us, certainly, this appreciation is not inseparably bound up with the perspective of lines and of atmosphere. Our most vivid impression of the third dimension is, in fact, independent of these. The striking relief in which objects stand that are within six hundred yards of us has nothing to do inherently with the factors upon which Dunan lays such stress. Within a certain distance of us, as the experiment with the pseudoscope just recounted shows, an object may seem nearer than another, in defiance of contrary suggestions of size or of linear or aërial perspective. Therefore these latter are clearly not the essence of our feeling of distance.

Rejection of the Platner-Dunan view.

There is no evidence whatever that the blind do not obtain something of this same plastic sense of the world through movements of the body and especially of their hands and arms, although the range within which they have it must certainly be less than vision gives to us. If, on the other hand, we were to accept Platner's belief as correct, that the world of those born blind is a spaceless world, it

would be difficult indeed to explain the instances where those surgically cured of blindness have been able to recognize simple forms by sight alone; and equally difficult to explain the rapid progress even the others make in familiarizing themselves with space. Distance and direction and size do not appear to be absolute novelties to these abnormal persons. Their real difficulty seems to be merely to interpret the distances and sizes and directions of their new experience in terms of their older, tactual life.

Touch and sight are each spatial.

We may conclude, then, it seems to me, that touch is a spatial sense in its own right. The visualists, like the tactualists, have a one-sided doctrine. For there is no single exclusive channel of this experience, but both sight and touch give us a first-hand acquaintance with the world of extension.

CHAPTER VIII

THE HARMONIES AND DISCORDS OF SPACE PERCEPTION, AND ITS PLACE IN EXPERIENCE

With their many incongruities, how do touch and sight ever harmonize?

We are thus brought to the view that the world of extended things comes in upon us through at least two distinct channels.[1] But this conclusion, consonant as it seems with common sense, brings a fresh difficulty in its train. For we have now to explain how sight and touch, which are fundamentally so unlike, can nevertheless make us feel that they are telling the self-same story. When we compare the conditions under which each operates, there seems to be nothing but a series of contrasts between them; and yet the results are somehow harmonious. When I hold a ball in my hand it touches and excites a large surface of the palm; but when I look at it, it stimulates a portion of the sensitive surface of the eye no larger than a pin's head. And yet the ball I see seems quite as large as the one I feel. Moreover, as I touch the object, it affects my hand; but as I look at it, it influences a portion of the body removed from my hand, namely the eye. And yet, in both instances, the object seems to us to be in the same place. As a

[1] That hearing is also an independent spatial sense (though much more limited in many respects) seems highly probable. Cf. Pierce, *Studies in Visual and Auditory Space Perception*, New York, 1901, pp. 180 *et seq.*

final contrast, the image in the eye lies in a reversed direction from that of the impression on the hand; and yet we see the object as lying in the same direction that it has for touch. In spite of all these incongruities in the tactual and the visual impression, the two senses work in perfect harmony and show us the same world. How is this to be accounted for?

It is no answer to say that we are never conscious of the retinal image.

It is sometimes said that there really is no problem here; that there is no need of showing how harmony can result from such antitheses, because we are never conscious of the minute image in the "fund" of the eye. It is true that the retinal impression is not felt in the eye, and yet this hardly seems to me to explain anything, but rather is part of the very fact that needs to be explained.

1. Why is the visual object projected, while the tactual is not?

Why is it, we may ask, that in sight we do not locate objects at the place where the sense-impression occurs, while in touch we do? Why this striking difference in our mental action in the two cases? It is certainly not because there is some native predisposition in the organs themselves to locate their objects in this different way. We do not do it instinctively. On the contrary, it is due to experience and associations. We *learn* that the things which give us touch sensations are at the skin; and likewise we *learn* that objects which give us impressions of light and color are not at our eyes.

Causes for not projecting touch impressions.

When a child grasps a ball, he can pass his other hand at once over both hand and ball. This independent observation shows that the object and the sensory surface lie in contact, and that it is not a case of action from a distance. The lips also feel hand and ball close together. And finally the eyes can observe

them both in the same glance. From repeated experiences of this sort it becomes a fixed habit to feel the object that excites the skin as lying against the skin itself.

Why visual impressions are not felt in the eye.

But where, now, shall the child locate the object that he sees? As lying against the retina of the eye? If the rest of experience supported such an interpretation, yes. But the fact is that the rest of experience suggests quite the contrary. In the first place, as the child passes his other hand over the hand grasping the ball, he does not come upon his eye lying against them both. His hand must make quite a journey after touching hand and ball before it touches the observing eye. Moreover, things that we know are hard and heavy do not impede the movements of the eyes when we look at them, while the same objects do check our movement more or less when we touch them. And so on *ad infinitum*. There are experiences enough and to spare to account for our reference of the objects away from the surface in the one case and to the surface in the other. There is no need of assuming that in vision there is an innate tendency to project the object. Nor, on the other hand, do we begin with a feeling that things are against our eyes, and later learn to project them.

Objection from cases of Cheselden *et al.*

Several of those successfully operated on for congenital cataract — Cheselden's and one of Home's patients, for example — did, it is true, declare that things seemed to touch their eyes. But this means no more, it seems to me, than would our own feeling on passing from a dark room into very dazzling sun-

light; something then often seems to "touch" our eyes; so strong is the accompanying feeling of discomfort and muscular contraction. For we must remember that just after an operation sight is usually coupled with pain and tears and muscular spasms; and since these are naturally, from previous experience, felt as at the eyes, it is little wonder that objects should seem in very contact. But Home's other patient who suffered little and, indeed, enjoyed the new experience so much that he could not be made to keep the bandages on his eyes, said that things did not seem to touch his eyes, although he could not say definitely how far off they were. In all probability, therefore, apart from previous experience, we begin without either projection of objects into space, or definite reference of them to the surface of the body. We have a tendency neither the one way nor the other; we simply let ourselves drift as experience itself carries us. If the experience had been radically different; if the world had been so constructed that objects regularly aroused pressure sensations without coming in contact with the skin; and if luminous objects had to come up to the retina in order to arouse sensations of light and color, our interpretation of these experiences would have been exactly reversed. Then we should have learned to see things as lying against our eyes and have felt the touch of them as coming from a distance.

II. How can there be a harmony in regard to the direction of objects?

But now as to the harmony which the senses show in reporting the more exact direction and position of things. For centuries a puzzling problem has been

to explain how we can see things right side up, although the image by which we see them is upside down like the picture on the ground glass of a photographic camera (cf. Fig. 29). Some, however, have taken the bull by the horns, and declared that this inversion of the image really simplifies the problem rather than renders it more obscure. They assert, paradoxically, that our vision of things as upright would be difficult — nay, impossible — to account for if the image in the eye were *not* inverted. The mechanism of the eye, they maintain, is such that it must of necessity make us perceive objects as in the reverse direction from that of the retinal image. If the image had been right side up, instead of inverted as it now is, this reversal in our perception would still have taken place, and we should in that event have seen things upside down. Upright vision, according to this doctrine, is dependent on there being in the eye an inverted image of the outer world.

Claim that the inversion in the eye is useful and indispensable.

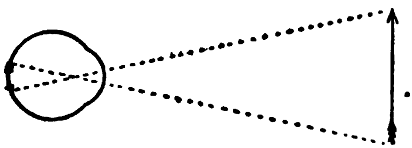


FIG. 29. — The normal inversion of the retinal image.

Experiment with reverting lenses.

Recent experiments, however, are decidedly against this conclusion. In order to see whether the inversion of the image was really so necessary as the advocates of this view supposed, an observer wore a set of lenses (as in Fig. 30) that turned the retinal image into an upright position for a considerable length of time. The results showed that an experience coming from such an upright image would in time be indis-

tinguishable from our normal experience. The first effect was to make things, as seen, appear to be in a totally different place from that in which they were felt. But this discord between visual and tactual positions tended gradually to disappear; not that the visual scene finally turned to the position it had before the inversion, but rather the tactual feeling of things tended to swing into line with the altered sight of them. The observer came more and more to refer his touch impressions to the place where he saw the object to be; so that it was clearly a mere matter of time when a complete agreement of touch and sight would be secured under these unusual conditions. And when once the sight of things and the feeling of them accord perfectly, then all that we mean by upright vision has been attained.[1]

Experiment with projecting mirrors.

A later experiment of a somewhat similar kind[2] has shown that the agreement of touch and sight can surmount even greater obstacles than these. A set of mirrors was attached to the body by a light frame so that the observer viewed himself as from above his own head. By means of screens on this frame, vision was confined as nearly as possible to the view which

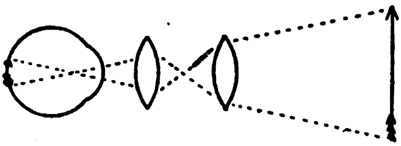


FIG. 30.—An arrangement of lenses giving an upright retinal image.

[1] A detailed account and discussion of these experiments will be found in the *Psychological Review*, Vols. III and IV.

[2] Cf. "The Spatial Harmony of Touch and Sight," *Mind*, October, 1899.

the mirrors gave, and these mirrors reflected things not only out of their proper direction, but gave them, as well, a false distance from the observer. Here again the result was, at first, an utter discord in the spatial reports of the two senses. The whole body was seen in a different place from where it was felt; it was in fact projected at a right angle to the front and several feet away, as indicated by the dotted outline in Fig. 31. But the constant sight

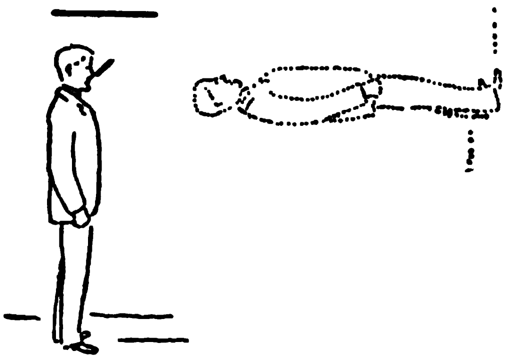


FIG. 31.—Arrangement of mirrors for projecting the body into a false direction and distance.

of the feet and hands, for instance, tended to pull the feeling of these members over into the place where they were seen, so that, on the third day, there were occasions, especially during rapid walking, when no conflict was felt as to the place of the various impressions. Such a harmony, it must be confessed, was only occasional; but that it could come at all, and particularly that it came more forcibly the longer the experiment was tried, shows

clearly what the harmony of the tactual and the visual space-world consists in. The experiment indicates that if we were to see a thing long enough in any given place, we should, sooner or later, also feel it there. If the world had been so constructed that we always saw our bodies a hundred yards away from our point of view, our touch sensations would undoubtedly have taken this same position. The reason for it is this: there is no place in the visual field where we can say beforehand we ought to see something that we happen to be touching. Experience alone can teach us where it will appear. And similarly, before experience has guided us, there is no way of telling where we shall feel an object that we are looking at. This is why those who are born blind and are suddenly given sight make such work of touching the things they see. They grope and fumble and seem to hit the mark solely by chance. But once a person has noted the kind of arm movement that will bring his hand to what he sees, then, when the visual experience is repeated, he naturally expects that if he repeats his former movement he will again touch the object. If he actually finds the thing there, he feels that touch and sight are in accord; if he finds it elsewhere, they seem to disagree. The agreement is, therefore, a matter of training and expectation. One can learn to expect anything that has been regularly experienced. So that a harmony of touch and sight can grow up under the greatest variety of circumstances, provided merely that the experience remains uniform long enough to develop fixed expectations.

What the harmony of sight and touch consists in.

Each must meet our expectations.

III. How can there be harmony as to the size of objects?

As for the size of visual objects — that in spite of the minuteness of the image in the eye, the object looks no smaller than it feels — doubtless some enthusiast will one day try the experiment of wearing glasses that make all things appear twice or thrice or half as large as they normally do. But even before the fact, in the light of the experiments already tried, we can pretty safely say what the outcome of such an experiment would be. At first the visual report of things would contradict the report as given by the hand, but in time the disparity would begin to pass away and the observer would become conscious of less and less incongruity in the two kinds of experience. If continued long enough the last vestige of disagreement would disappear; things would seem to be of the same size whether seen or touched. For the amount of surface that an object covers in the eyes has but little to do with the extent of the object as we see it. The size of a thing for us is a relative matter; it is its extent as compared with other things. Now the image in the eye, tiny as it is, gives all things in due proportion; it shows me my body as about the size of my fellow's, it shows my arm as smaller than my body, my hand as smaller than my arm, and so on. The relations here are exactly the same as those that touch reports; and so the two senses agree here also, in spite of the strangely different conditions under which they operate. The all-important thing is not the absolute size of visual images or of touch-perceptions, but that the relations should be kept intact — that when touch reports a thing to be half the size of another, sight should

Absolute size of the impressions is unimportant.

The inter-relations are the essential thing.

tell the same story. This relation of things to one another is shown as well upon one scale as upon another. The absolute expanse of the picture is of no moment so far as the mere harmony of the space-perception is concerned, although for other considerations it is important that the image should be neither too large nor too small. So that here again it is a matter of training and expectation. Experience alone can teach us how much space the object we are touching shall occupy in the visual field. Any other amount of space would do quite as well, provided all other things were in proportion. But once our expectation has become set; once we have felt how large our hand, for instance, is and then have seen it, the two experiences stand for each other thereafter and the two sizes seem identical. But they would likewise have seemed identical if the visual experience had been tenfold or one-tenth of what it now is. In all these different aspects — whether it be of size or distance or direction — custom and habit are the great forces which tend to bring a harmonious result out of the most contrary conditions.

The permanent discords of touch and sight.

But one can dwell too exclusively on this concord that seems to prevail in our mental construction of space. The experimenter, in fact, is constantly running upon minor discrepancies in the reports of the senses. For instance, the smooth edge of a card pressed upon the arm will feel shorter than it looks; or when the finger is run along a row of raised points, such as the blind use in reading, the distance will in many cases feel shorter than this same stretch does

when marked off by the two terminal points alone; while vision gives just the opposite effect: the dotted distance now seems longer than the same stretch free from dots.[1] These inconsistencies persist perhaps chiefly because they have to do with out-of-the-way operations, and the errors are of no practical importance. For the spatial agreement of the senses goes only so far as is needed for ordinary conduct. Nature is no enthusiast; she does not rush into the work of harmonizing our space-faculties as an end in itself and to be carried out with Ruskinian fidelity and conscience. The whole matter is dropped at the point where it ceases to minister to the practical aims of life.

Discord is annulled only when it does harm.

Space-perceptions are at times non-Euclidean.

But not only does our space-experience thus have its unfinished nooks and corners, but at times it seems to do violence to the principles of at least the older geometry. According to Euclid, for example, the sum of the angles around a point is, when the angles are all in one plane, exactly equal to four right angles; and if we enlarge certain of the angles about this point we do, by just so much, diminish the remaining angles. Now in our actual perception this does not always hold. In Fig. 32 the angle *AOB* seems to be a right angle; likewise *COD*, *DOE*, and *EOF*; and yet in the same plane there remains over and above these an angular distance *AOF* and *BOC* that is not included in them. The psychological

Examples.

[1] When we take very small distances for touch, say one centimeter, as the total dotted distance, the illusion is in the *same* direction as in sight. Cf. Robertson, "'Geometric-optical' Illusions in Touch," *Psychological Review*, November, 1902.

effect here is in violation of our usual geometrical assumption that the subdivision of space does not alter its quantity; for the minutely subdivided angles

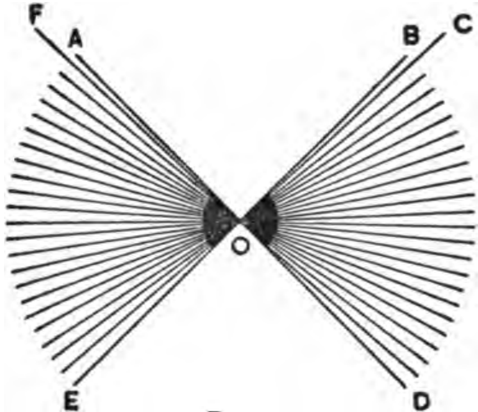


FIG. 32.

seem greater than those not so subdivided. And, moreover, we see here that the enlargement of two of the angles *AOE* and *BOD* by subdivision does not appear to make them encroach upon the space occupied by the neighboring angles *AOB* and *EOD*. In the case of parallel lines, also, our experience actually brings together properties that are (according to the Euclidean geometry) impossible. In Fig. 33 the lines *AB* and *CD* seem to have the same general direction, and yet

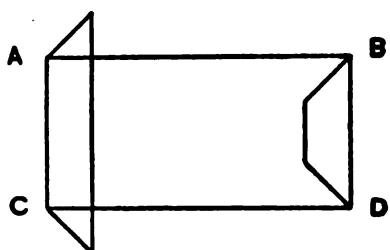


FIG. 33.

the distance between them at one end (AC) seems greater than at their other end (BD); or if there does seem perhaps to be some difference of direction in the lines, it is hardly as much as ought geometrically to go with this inequality in the apparent distance between their ends. Psychologically, too, the possibility of superposition is no evidence that the figures will be identical when not superposed. The accompanying forms (Fig. 34) seem of different size and shape, and yet a perfect coincidence of outlines is possible. And, finally, of three points lying in a straight line, the middle point may appear to move at right angles to this line, and yet it may not seem at any moment to be out of line with the other two stationary points. This experiment may be performed thus: if we arrange the points say vertically (as in Fig. 35) and have behind the middle one a set of short vertical bars mounted on a drum that is revolving slowly from right to left, and we observe fixedly the middle point for some time and then suddenly stop the passing bars, the middle point as we continue to look at it will then seem slowly to move from left to right while the other two points remain stationary; and yet we can see that it remains all the while in line with these two points.

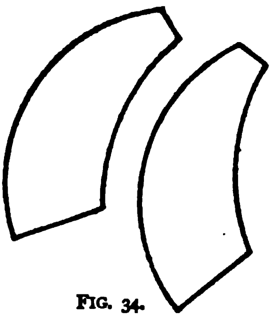


FIG. 34.

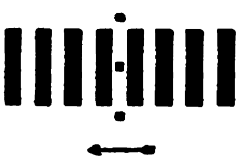


FIG. 35.

The obvious objection to taking these exceptional phenomena seriously would be that they are mere illusions, and therefore have no bearing on the question of the universal validity of mathematics. For geometry is a science of real space, the objector would say, and these aberrations are mere appearances, not in the least indicating that actual space itself is irregular or non-Euclidean. As well might you claim that the law of gravitation is untrue because we can dream of objects falling away from the earth.

These instances are mere illusions.

This, I feel, would be a sufficient answer to any one who might cite these space-illusions to show that geometry was untrue to the facts of the outer world as we empirically know them. The character of the outer world — of "real" space — is not affected by these inner vagaries of our sense-perception.

But it would seem to me that the illusions in question have a bearing upon the validity of the traditional geometry in any *possible* experience — the question with which Kant has dealt so profoundly in his "Transcendental Æsthetic." His well-known position is that geometry must of necessity hold true universally because its laws are somehow involved in the very structure of our sense-perception, and, consequently, that it would be impossible for us to have any experience without impressing these laws upon it.[1] For one who would gain this pitch of

Yet even illusions have a bearing on Kant's doctrine of geometry.

[1] The only direct reference to illusions and to their possible bearing that I can lay my hands on in Kant, is the meagre and unsatisfactory statement in the *Anthropologie* (Hartenstein, p. 457) that they are *Erscheinungen* and not a part of *Erfahrung*, and apparently that ends them.

certainty for geometrical truths, the space-illusions in question would seem to deserve a little more consideration. They can hardly be ruled out of court at once because they are subjective and illusory, for as illusions they are a kind of experience. And if our sense-experience can in special instances depart from the principles of geometry, this might cast some doubt upon the assumption that any possible experience would of necessity conform to Euclid.

They are a kind of space-experience.

Our anti-geometric space-perceptions show at least this much, that if the older geometry is to remain logically valid, space-experience must be understood as including more than the mere sum of impressions that is contained in any limited stretch of time, and more than the mere sum of impressions gathered in even a practically unlimited duration. The "experience" of five minutes may contradict the traditional geometry, but hardly the experience of many years. And what we call the experience of this longer period is after all a kind of idealization of what we have gone through. We do not give equal weight and value to all perceptions alike. On the contrary, we become impressed with the need of system and harmony, and we subordinate and neglect those perceptions of space that do not accord with the more perfect plan. If experience in this selective sense conforms to our geometrical theorems, the conformity must not be understood as due to the psychological character of our sense-perception in each of its particular acts. Every single piece of space-experience does not come with the laws of geometry stamped upon it. Only in so far as our particular perceptions

To avoid the difficulty from illusions, experience must be understood as of unlimited duration,

and as a selected set of perceptions.

are brought together into an ideal system, and those perceptions that refuse to conform are ruthlessly cut off, — only with this meaning of spatial experience would there be no conflict between psychology and the older geometry. What we call the experience of "real" space is consequently a kind of idealization or purified experience obtained after sifting out and discarding those perceptions that are practically unreliable. Practical utility — the idea of interrelating our objects so that they may serve as the safest guide for conduct — is thus a most important factor in making this ideal construction of space.

"Real" space is thus experience idealized.

The illusions we have been considering have also a further interesting bearing on the psychology of real space and of the real world. At the present day there is a strong tide in the socialistic direction. The interaction and friction of social life, rather than the inevitable inner development of the individual or the interaction between the individual and his impersonal surroundings, are being more and more emphasized not only in ethics and sociology, but in psychology and even in metaphysics. The real world, the external spatial reality, for each of us, according to this modern tendency, is that portion of our total experience that is found to be common to us and our fellow-men. What is over and above this common stock is judged to be subjective and "internal." But these space-illusions show that too much stress can be laid on our collective or social experience as the test of what exists in "real" space; it is not the absolute and final test, after all.

Is real space a social construction?

The social test of reality has been made too much of.

has no essential extension whatever. In listening to a great orchestral composition it is true that there is usually some hint of space-relation. The sounds of the different instruments seem to come from more or less different directions, and to be in varying degrees voluminous. But these associations seem to be quite fortuitous and are not essential to the structure and beauty of the piece. For our space-suggestions detract, if anything, from our clear perception of the music, which is a structure merely of duration, intensity, and pitch. So that our appreciation even of a single musical chord is evidence that time itself has more than one dimension, and allows mental impressions to come abreast. Consequently it cannot be urged that our perception of space is a necessary outcome of sensations coming together and yet remaining distinct. Harmony and discord are not extension. In fact, space cannot be reduced to a mere association of non-spatial sensations. For any mere addition of unextended things could no more be equivalent to space than a sum of zeros could produce a quantity.

Extension is psychologically irreducible.

At what stage of development does it appear?

Space as a psychological fact is therefore a unique addition to the mere quality, intensity, and duration of our impressions, although it is dependent on these factors. Just at what point in our mental development this peculiar factor enters, is not known. Professor James and Dr. Ward are of the opinion that extension or voluminousness is inherent in all sensations, and consequently must have been there from the very start. In this they may or may not be right; for it is impossible as yet to know the

facts. No direct examination can be made of the sensations of creatures at the earliest stage, and their reactions are at best ambiguous. Jennings's excellent experiments on *Paramecia*[1] show that these unicellular creatures give the same machine-like response regardless of the place where they are stimulated. They back-water and turn, always in the one direction, no matter from what point the excitation comes. So that there is no positive evidence that they appreciate the position or direction of things. Another unicellular organism, *Stentor*, however, gives most varied responses to different stimuli, and moves in different directions according as it is gently touched upon one or another side.

Sensations, if extended, are not "pure."

But if by the word "sensation" we intend to designate something absolutely unorganized and elemental, — the simple material of our mental life, without form and void, — then the doctrine that even our earliest mental impressions are extended, simply means that a pure sensation never exists, not even at the very beginning; that an absolutely formless and disorganized impression is an idol of the psychological cave. For voluminousness in a sensation implies that the thing is complex; that there are differences held together in some sort of space-relation, vague though it be. If, then, the sensations of an infant long before birth, or of the protozoan, have in them the "quality of extensity," these sensations have form

[1] Jennings, "The Psychology of a Protozoan," *American Journal of Psychology*, July, 1899, with the references there to his other articles. For an account of his latest experiments on *Stentor* and *Vorticella*, see the *American Journal of Physiology*, October, 1902.

or arrangement, and are therefore not utterly disorganized mental stuff, or *pure* sensation.[1]

They probably are organized from the beginning.

From the analogy of the body we should certainly expect something like this, — that the mind too would, from the beginning, be organized. For the body, even in the earliest single-cell form, is never absolutely simple and undifferentiated; it is always a union of different parts. Why, then, should we assume that the mental life is less complex? If there is any truth in the doctrine of the correspondence between physical and mental characteristics, the psychic life even at its earliest stage consists in some kind of organization of sense-impressions.

But the organization need not be spatial.

To infer from the analogy of the body that the mental materials are never quite "raw," but are already to some extent worked up, by no means determines what is the form of that earliest mental life. It simply implies that it has some organization or other, without deciding however that it has this special and particular form of *space*. For there are many other conceivable forms, such as the mere time-form, or perhaps, simpler still, mere sense of qualita-

[1] Ward, of course, would quite agree with this (cf. his *Naturalism and Agnosticism*, Vol. II, pp. 112, and following), and James, too (cf. his *Principles of Psychology*, Vol. II, pp. 3, 4). But if pure sensations are an abstraction, as James says (and, the present writer feels, correctly), why should he speak of their being "realized in the earliest days of life" (*op. cit.*, Vol. II, p. 7) any more than in adult life? Sensation is, of course, present all through life, but only as an abstract aspect of experience. Relatively, of course, it may be more prominent in infancy, but never absolutely "realized." We should hardly say, for instance, that the abstraction of surface without volume is realized in a sheet of paper but not in a block of wood (cf. note on "Matter" and "Form," p. 231 of this book).

tive contrast, that might well precede and lead up to this more complex fact of spatial feeling. This is a question of fact that cannot be settled by the *a priori* method. For there is no logical necessity that our sensations should be extended at the very start — such a necessity, for instance, as that sensations should have some intensity if they are to be experienced at all. And when we say, with the Kantians, that our experience of extension is due to some inner activity of the mind, it does not seem to me that we need assume that this particular activity is always in evidence, any more than that the categorical imperative is especially manifest in the earthworm or the oyster. But whether it is always there, as James and Ward suppose, or only appears at some later stage in the mental development, its presence, in either event, is an irreducible fact, and not to be regarded as an inevitable outcome of the merely temporal arrangement of our sensations.

Psychology and the deeper questions of space.

But here the consideration of our topic must close. It is already clear that the psychology of space-perception passes insensibly into the metaphysical realm, and into that region we must not attempt to follow it. An effort has here been made to keep at least within sight of the more experimental aspects of the case, — the way our minds obtain a picture of the expanse of the world, the senses on which we depend for this, the hints and clews by which we find out the place and size and shape of things, and how out of the confused and contradictory data there comes a consistent panorama of the world. We obtain in this way some hint of how this strange power within us works, but

cannot after all by any of these means account for it or derive it from deeper causes. For the psychologist it remains, in its origin, one of the ultimate processes of our mental life, like our sense of temporal sequence or of beauty, or our power of taking interest in things, or of exercising will. Whether it must of necessity be present in all minds, or whether if it were present it would reach the same results as in our case, psychology is unable to say. And although it is a power which lies so deep within us, yet it seems less central to the mind than many of our other powers. It has not the same moral place in us that memory or judgment or conscience has. For this reason it is treated lightly by the mystics, as being but an outer garment of the mind, a mere external symbol of our deeper spiritual states.

CHAPTER IX

MEMORY AND THE INFLUENCE OF TIME

Memory, if understood, would make all clear.

If we could thoroughly understand memory, the rest of the mind would give us little trouble; for this one field practically involves all the problems of psychology. There is often a temptation to pass over it lightly as a mere illustration of habit or of association; and in the chapters on unconscious ideas I may have given the impression that there seemed to me to be nothing more to it than a mere repetition of a previous mental act. But we must now do justice to memory and point out the marvellous intricacy of this familiar function. After we have done our best to simplify it and have regarded it as merely the return of a former idea, we discover that there is a flavor and meaning about our memories which still remains unexplained. The peculiar backward look which our recollections have is something over and above their mere return. Many of our ideas return, but they have no familiarity, we do not recognize them; they mean nothing historical; they are not memories, therefore. So that a memory is a peculiar type of recurrent idea that is somehow greeted as a record of the past. Moreover, it is difficult to explain our confidence that memories have historic truth — to discover what it is that permits us to recognize them

as copies of what has gone. In looking at the portrait of a friend we can say that it is a good likeness because we can compare it with the man himself or with our recollection of him. But when we recognize our memories as true copies of the past, we have not the past itself there nor some other copy of it with which to compare them. And yet the recognition is ready and accurate. Through memory, indeed, the mind seems to be not only in the time-stream, but also outside and around it, looking down on both past and present as from some point remote from both.

The field of experiment here.

Into this deeper side of memory our experimental studies have hardly gone; they are confined more to an investigation of the way our ideas fade with time and of other changes they undergo, and of the different kinds of memory we possess. In such matters as these, most interesting work has been done, and of that I shall try to give a brief report.

Ebbinghaus's studies.

The experiments of Ebbinghaus[1] were the pioneer studies of this kind; and one of the principal problems that he set before him was to determine the law according to which forgetfulness takes place. Common experience makes it clear that time is of course an important factor in forgetting; that as time elapses we forget more and more. The most interesting of Ebbinghaus's experiments had as their object the determination of the varying *rate* at which this loss takes place. His method of investigation was certainly unique. He worked with a large number of nonsense syllables made for the occasion by putting together,

His method

[1] Ebbinghaus, *Ueber das Gedächtniss*, Leipzig, 1885.

haphazard in each case, a vowel between two consonants, — like *tul*, *min*, *baf*, *cug*, *jat*, — and heroically learned these by heart. He first found how many times on an average he must read over a list in order to be just able to repeat it without error, from memory. A certain length of time was allowed to pass, and then of course the list could not be correctly recited; it had to be re-read several times before it was restored to the point where it could just be recited once without mistake. The number of re-readings thus required to restore it to its original clearness, compared with the number required to learn the list the first time, gave some measure of the degree of forgetfulness that had occurred in the interval. By varying this interval all the way from twenty minutes to a month, and carefully noting the difference in the result, an interesting table was obtained of the varying speed at which oblivion comes on. Ebbinghaus found that in a single hour over one-half of what he had learned had been forgotten; after eight hours three-fifths was gone; after twenty-four hours, two-thirds; after six days, three-fourths; after a month, four-fifths; or, in other words, more was forgotten in the first hour than in all the weeks succeeding. We might represent his results by the accompanying curve (Fig. 36), in which the slant indicates the rate at which forgetfulness ensues, the distance on the horizontal line representing the passage of time. At first the slant is well-nigh perpendicular, the descent being very sudden, and then becomes ever more gradual. **and results.**

The *absolute* values obtained by these experiments have no especial significance. They must **Their significance.**

not be understood to mean that in every case, regardless of the materials with which we are dealing, we forget in the first hour fully one-half of anything we learn. Allowance must first of all be made for dif-

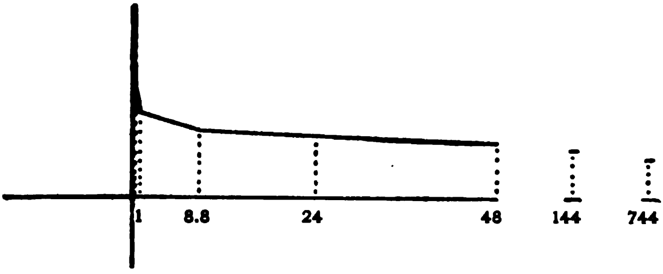


FIG. 36. — Curve showing the rate of forgetfulness, according to Ebbinghaus's experiments. The values of the abscissas represent hours.

ference of materials; some things are more fascinating than nonsense syllables; they take a more vital hold of us, and consequently fade away at a much slower rate. And of course different absolute values in the results are always obtained with different persons. Some are more tenacious of a given kind of fact than others are. Ebbinghaus's experiments just described had largely to do with the particular power to repeat a series of muscular acts, — of articulatory movements; and, in this, "ideas" and consequently memory as a mental act doubtless played some part, although probably a subordinate one. But in experiments where the recollection has to deal with more strictly mental things — where a person has to pass judgment on an impression given several minutes before — the results are probably, here also, in accord with Ebbinghaus's general principle. For

short lapses of time, however, — for a few seconds, — as I shall point out later, the behavior of memory is by no means so uniform and simple. Only the larger relations in Ebbinghaus's results, therefore, are significant and universal, namely, that the clearness of our recollections fades away according to a law of diminishing or retarded speed, whatever the speed itself may be. So that in the life history of ideas the probability of long continuance is the greater the longer the idea has already been able to hold its own. Anything that is not early devoured by time has a fair chance for sublunary immortality.

The mutability of our ideas.

Now, this rapid and then more gradual blurring of our impressions as time goes by must not be confused with the actual distortion which events often undergo in memory. Memory is often thought of as illustrating the constancy of our ideas. We speak of things as indelibly stamped or graven on the mind, or liken memory to a gallery where the past is preserved in lasting pictures. In discussing the arguments for unconscious ideas, I have already criticised this view, chiefly on logical grounds, because of a certain incoherence in the view itself. Our ideas are not solid things that exist during forgetfulness, but are acts which in many cases we may repeat and re-create as occasion calls. The same truth is enforced in another way. For if ideas were actually stored up in memory as permanent and stable realities, still existing during the interval of forgetfulness, we might expect them usually to appear unchanged as we recalled them at different times. But there is often the greatest contrast between my present recollection of an event

Memory both blurs and distorts.

and my recollection of it some moments hence. The memory not only grows less clear, but it actually tells a different story as time proceeds. Now there is in psychology a frequent confusion of these two independent facts of memory, — the fact of forgetfulness in the sense of blurring, and of forgetfulness in the sense of distortion. We are at first naturally tempted to represent forgetfulness merely after the manner of a light that fades, or of a substance that evaporates or melts away. If the latter figure of speech represented the facts, there would most naturally be a change in the quantity of objects as we forgot them. A half-forgotten house might be but half the size of the same house fully remembered. Or a fire in memory would, perhaps, give out but a fraction of the warmth that we enjoyed as we sat beside it; a recalled pound might weigh but an ounce, and so on.

Some experiences shrink in memory,

Absurd as all this sounds to the unbiassed mind, there have been a number of experimental facts to encourage the view that forgetting was equivalent to a diminution of the intensity or size of the original impression. Thus it is true that objects are judged to be of quite different quantity according as they are sensibly present or are only recalled. Sounds, for instance, are often judged to be less loud as they fade into the past. If we listen to the stroke of a falling ball (dropped, say, from the upper magnetic holder of the instrument in Fig. 37), and some moments later a second stroke be given which shall *seem* exactly as loud as the first, we must make this second stroke slightly fainter; we must

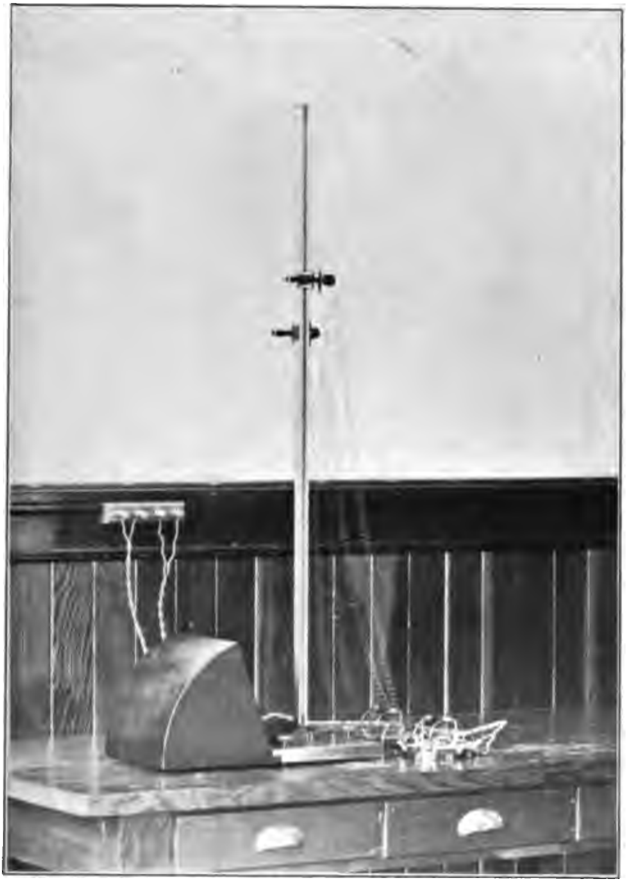


FIG. 37. — Instrument for measuring variations in the memory for sounds.

have the ball fall from a point not so high, — perhaps from the lower ball-holder in the figure. If we make the second sound of the same actual intensity as that which has preceded, in the long run it will seem louder than the first one. This means of course that the recalled sound is represented as having less strength than it really possessed. But with certain intensities of light, on the other hand, the very opposite effect is observed. The remembered light seems brighter than it really was. And also with some simple space-forms, the objects seem to increase rather than diminish as time goes by. If a single square of moderate size be shown, and then, perhaps, twenty minutes later, a number of squares of various sizes be displayed, in selecting the one that seems to be equal to that presented earlier, too large a square will usually be chosen. In looking back over the stretch of twenty minutes the figure is thought of as larger than it really was. So that it is impossible to say that forgetting is equivalent to a quantitative *decrease* in the object forgotten — that time always shrinks things. It may, on the contrary, make them loom up the larger, as things do when seen dimly through a mist. The fruits of the West never seem to the emigrant quite equal to those of his New England farm. The golden age, the *laus temporis acti*, are but illustrations of this intellectual mirage which time produces. Some things increase while others decrease; memory distorts everything for better or worse.[1]

while others expand.

[1] Cf. the late Professor Kennedy's article "On the Experimental Study of Memory," *Psychological Review*, Vol. V, p. 477, for many details of

No necessary connection between distortion and blur.

We cannot say that there is any necessary connection between the indistinctness and the distortion which comes over our recollections. We could well imagine a kind of mind in which things would be distorted in memory without becoming indistinct, or would grow indistinct without suffering further change — without seeming larger or smaller, or stronger or weaker, or better or worse. The relation of these different phenomena of memory might be illustrated by the human voice. Recollection is like a voice repeating something from an ever increasing distance, but which, besides growing fainter, tells a different story as it passes into the distance. The growing indistinctness in the voice would be comparable to the law of forgetfulness which Ebbinghaus's experiments brought out. The change of story

such experiments. As to the character of the memory-image itself, as set forth in my text, it should be said that there is increasing evidence that when a comparison is made between a present impression and one that occurred some time before, there often is no conscious *picture* of this earlier occurrence (cf. *e.g.* Bentley, "The Memory Image and its Qualitative Fidelity"; also Angell and Harwood, "Experiments on the Discrimination of Clangs for Different Intervals of Time," both articles in the *American Journal of Psychology*, Vol. XI, No. 1, October, 1899).

But whenever there is a judgment with reference to a preceding impression, it would seem that we are conscious of the past occurrence in some form or other, if not in kind, at least symbolically or "implicitly." I have, therefore, continued to speak of an idea or representation of the past experience as involved in all these acts of comparison or discrimination without, however, wishing to stand by the memory-image view in all its rigid literalness. The representation of the past occurrence, whether it be in the form of a picture or of something more obscure, certainly undergoes alterations corresponding to what I have called indistinctness and distortion.

would stand for the distortion which things suffer in memory. It has been one of the errors of psychology to confuse these two aspects and to explain all the cases where memory minimizes things as simply due to the fainter voice with which memory speaks.[1] But this is entirely beside the mark. There is no necessary connection between the strength with which words are uttered and the amount of meaning they convey. We can exaggerate in whispers, or belittle a thing in thundering tones.

The distortion is difficult to explain.

Why there should be any distortion at all is not yet understood. In some cases the alteration seems to be the result of an effort to make things more uniform in memory, — to bring them nearer an average. A very dim light, for example, becomes brighter in memory; while a very bright light becomes dimmer, as if by gravitation in both cases toward the mass or average of our experiences.[2] But often just the opposite tendency seems to be present. In my own case, if two exceedingly shrill notes of a Galton whistle, near the upper limit of audible tone, be given with an interval of time between them, even when the two are of identical pitch, the earlier one always seems to be the higher.[3] The extraordinary experience, instead of being forced toward what is normal, becomes even more extraor-

[1] For an example of such an error, cf. von Tschisch, "Ueber das Gedächtniss für Sinneswahrnehmungen," *Bericht ü. d. III Internationalen Congress für Psychologie*, Munich, 1897, p. 106.

[2] Cf. Leuba, *American Journal of Psychology*, Vol. V, pp. 382 *et seq.*

[3] From experiments on others, however, I am sure that this is not universally the case.

dinary as it is recalled. Fresh and marvellous features are thus involuntarily added to what is surprising, in order to justify even to ourselves the effect which we remember it produced upon us. The same tendency is seen in the larger corporate memory of society, in that every great historic figure, like Luther or Napoleon, soon becomes the centre of a myth. But, again, the tendency may be still more irregular, so that it cannot be described either as a simple exaggeration or as a mere diminution. The same remembered fact may be enlarged at one moment, only to be reduced again as it gets farther into the past. Thus the selfsame sound or light may, after two seconds, be thought of as stronger than it actually was, while after two minutes it may have fallen off and be regarded as considerably weaker than the original fact.[1] This, too, represents in miniature what we see on a larger scale in history, where for some brief time after an event its importance is exaggerated, only to be undervalued perhaps at a still later day.

Clarification in memory.

But after we have told the whole damaging truth about memory and about its tendency to distort and obscure the facts, we must do it justice as regards its occasional power to make the facts more distinct. After an interval has elapsed, an experience may be less blurred in memory than it was immediately after its occurrence. The clearest and most faithful view of things is here to be had only in the later memory.

[1] From experiments by students in the psychological laboratory of the University of California, an account of which will be published soon, I hope.

picture. It is said of experts in tasting wine or tea that their finest discriminations cannot be made until the taste is out of the mouth. And certainly any one who tries to observe his own mental states will find something similar to this; he can tell but little about them until they are off at arm's length — until he can see them somewhat in perspective. An emotion or an act of will can be best scrutinized only in memory, so that introspection is always more or less a matter of retrospect. In these cases memory seems to offer a more stable and trustworthy basis of judgment than the sensible fact itself. So, in much of our laboratory work, it is found that the nicest distinctions are noticed when the two impressions which are to be compared come in succession rather than at the same time. Two weights pressing on the skin simultaneously cannot be distinguished until one of them is about one-third heavier than the other. But if we give them successively, a difference not a tenth as large as this can often be perceived. In music, the untutored mind has infinitely greater readiness in comparing the pitch of tones if one follows the other. For this reason, melody is easier of comprehension than harmony; few can mark at once all the different notes in a chord; we appreciate its general character rather than its individual constituents. In the case of sight, it might seem that the most favorable conditions for comparing things — two colors, for example — would be when both were present at once. But even here, although the things stand there together, we actually compare them by running the

eye back and forth, and thus make the experience of them successive. If we put them close together and look at them fixedly, both at once, the judgment is less secure. Now, in all these cases where comparison is easiest, we are in some way working by memory; we have to retain some idea of the preceding impression and compare it with the one that follows. It is evident, therefore, that what was said about the obscuring effect of memory as compared with the vividness of the original impression, cannot be the whole truth.

The understanding plays a part in memory.

The fact is that experience is a much less sensuous matter than we often believe; the process of clearing up our experience — of making it stand vividly before us — depends by no means exclusively on the mere strength and liveliness of the sensations of the moment, but on subtle processes which belong to the understanding. And these processes work slowly, and, at any given moment, over a comparatively limited field. We imagine that our minds receive things in the lump; but even in our most rapid observations and with the simplest things, the object gradually dawns upon us; it comes, now a part and, later, another part. If a very simple form be shown but one brief moment, — $\frac{1}{500}$ of a second, perhaps, — the light may be strong enough to give a distinct effect upon the eye; but only a portion of the figure is grasped by us, or we get a suggestion of something quite different from what really appeared. A second exposure of the same length partially supplements or corrects the first; a third makes it still more distinct; until with successive views the figure at last emerges clear. In Fig. 38,

The source of the increased distinctness.

column *O* gives the actual form of some outlines exposed in this way; the other columns (1, 2, etc.) give the successive drawings, all by the same observer, showing the apparent development with the successive exposures. Now each successive view hardly adds to the clearness of the impression *upon the eye;* the growth in the perception is not a matter of more vivid sensation. The growing distinctness in the experience is rather due to our scrutinizing attention — to our holding in memory what had been gained, and adding to this successively until we finally have a distinct picture of the figure. Not until we ourselves have built it up at the suggestion of the sensations, have we really mastered the sense-impressions and made them ours. This intellectual construction requires not only time, but it requires also freedom from distraction; and when several things are present at once it seems impossible to give each that undivided attention which is possible when

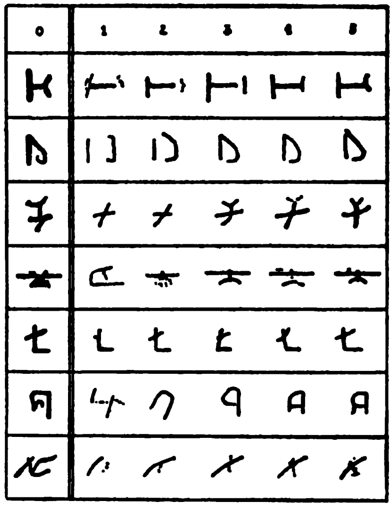


FIG. 38. — Examples of the gradual development (columns 1–5) of the subjective image after very short exposures of an object shown in column *O*.

they come to us in succession. Simultaneous things, consequently, are more difficult to compare because each is clamoring for attention, and so we cannot scrutinize perfectly any one of them. The sense-materials are clear enough, but the intellectual function is at a disadvantage. Now this intellectual part, this grasp of the thing, may continue to develop after the object is no longer sensibly present. In fact, in some cases, the sensible presence of the object really hinders our understanding of it. After it is gone, the attention is more elastic and alert, the various relations are better seen, so that the natural fading in memory of the sensory impression may be offset, and more than offset, by this retrospective clarifying through the understanding. In historical studies it has become a truism that the present is what we know least about; it is all confusion, and nothing clears up until it can be viewed from a distance. The same holds true in a large measure in regard even to the inner experiences of our personal life. Thus it is extremely significant that careful experiments on the memory for tones, for light, and the like, often show a steady improvement of memory, rather than a falling off, during the first five seconds (and sometimes longer) after an impression has been received.[1] Over against the general law that memory allows the facts rapidly to fade, we must therefore set up the opposing

A clearer retention precedes the blurring.

[1] Such an improvement, for instance, is noticeable in several parts of the tables of Bentley (*American Journal of Psychology*, Vol. XI, p. 42), of Angell and Harwood (*ibid.*, p. 76), as well as in those of Saborski (*Bericht ü. d. III Internationalen Congress für Psychologie*, p. 103) and Hirschberg (*ibid.*, p. 107).

principle that time is frequently one of the most important factors in clarifying our experience, and at first often builds up more rapidly than the other influence pulls down. So that in all hasty or unstable experiences the very maximum of clearness is reached not while the impression is upon us, but immediately afterward, in a single early throb of memory.

The retention of different sense-materials.

But the laboratory work on memory has made perhaps its most interesting finds in laying bare the different ways our memory has of dealing with different materials. Men used to think of memory as a great receptacle, that was, like most receptacles, indifferent to the kind of things put into it. A "good" memory, it was thought, could retain anything; a poor one allowed everything to escape. Each of us was supposed to be possessed of a certain grade of retentiveness, equally tenacious or negligent (as the case might be) of all things committed to it. But it is now known that this is not the fact. With all of us the power of retention is very different for different things. And even within the limits of a single sense in the same person great differences may be found. Von Tschisch not long ago laid it down as the result of his students' experiments that there is a regular improvement of memory as we pass from the lower to the higher senses, that we remember best of all the things we see and hear, and poorest the objects of touch, while somewhere between the two comes the memory for facts obtained through the muscles.[1]

The usual ranking of the senses as "higher" and "lower"

[1] W. von Tschisch, "Ueber das Gedächtniss für Sinneswahrnehmungen," *Bericht ü. d. III Internationalen Congress für Psychologie*, p. 95.

hardly fits the facts here.

The senses are probably not related, however, in this simple and orderly progression; and whether we grade a sense as higher or lower depends very largely on the particular features that we are considering. We are, as a rule, undoubtedly more tenacious of the size of objects offered to the eyes than of those which touch our skin. But in respect to the memory for the *intensities* of impressions, there is a reversal of our usual classification of high and low. Sight is now the poorest of all, hearing is only less poor, while the muscular sense and touch stand highest in the scale.[1]

The first may be last.

It is hardly probable that the difference in the rate of fading of different aspects of our impressions is due to any peculiar quality of the impressions themselves; we have no evidence as yet that some features of our sensations are inherently more perishable than others. It is rather because some have become more significant and have a practical value and interest which others lack. Those features of our impressions which in the long run stand for the most, which have the richest and most permanent associations—these enter into the very weave of our mental life. The actual and absolute brightness, for instance, of the light which comes from objects is decidedly less important for dealing with them than are their shapes and sizes. The absolute brightness changes constantly with the weather or the time of day, but not so the form. And similarly the absolute loudness of sounds, while important for judging distance, is of

Utility as the determining factor.

[1] From the results of experiments by my students, referred to a few pages before.

far less general importance for telling whether things are harmful, and for purposes of communication, than are the peculiar qualities and pitches of sounds. For this reason our power to recognize the pitch of a sound given some moments before, poor though it may be, is usually better than our ability to recognize the particular intensity or loudness of the sound. On the other hand, the weights and pressures of objects are often permanently characteristic of them, and are important for our recognition and practical treatment of them. The superiority of our faculty to recognize intensities of pressure and muscular strain as compared with our recollection of the intensities of sights and sounds is consequently a matter of biological utility.

Effect of altered conditions.

The importance which certain features of experience shall have is not, however, a fixed matter and alike in all persons. In many cases — in the blind, and in the deaf, for example — the relative values of different kinds of impressions may be unusual. When a person must depend largely upon touch, he may have a memory for gradations and niceties in this field that is astonishing. If there is any truth in the common belief that the blind can at times distinguish colors by feeling, it must be that different dyes give characteristic impressions of touch — gritty or smooth or cold — which are noticed and remembered and classified and associated with our color names, but without any true perception of the colors themselves. But while the memories of the blind are richly furnished with tactual ideas, sounds also have a prominent place with them. In recalling persons their thought circles about the voice, while with us

such recollections group about the appearance of the face. Their dreams, too (which are a kind of memory), are largely in terms of sound, often running, even in persons not especially interested in literary matters, into the form of verse.[1] One of the most interesting things in Raehlmann's account of the relief of Christine Deutschmann from congenital blindness is the pleasure the woman took in the change that came over her dreams; they became visual pictures where she had before of course seen nothing.[2] The deaf, on the other hand, when dreaming or when delirious, imagine and at times actually produce the movements of the manual sign language where we should hear or use the voice. Likewise in the animal world, memory must take on an entirely different tone, and the relative tenacity for various

[1] Cf. the interesting account of the dreams of the blind, by Friedrich Hitschmann (himself blind), "Ueber das Traumleben des Blinden," *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*, Vol. VIII (1894), p. 387.

To illustrate the rhythm feature, he gives from the dream of an unliterary friend: —

"Es trippelt Freund Hein
In der Nacht
In der Nacht
Ganz sacht."

The dreamer then murmured to himself (still asleep): —

"Zwölf Worte, zwölf Tote, es stimmt."

He says that he himself often hears whole lectures in his dreams. The touch element, according to him, is almost if not quite absent. For instance, he dreams of a fire, but feels no *glow* from it; it seems to be more a matter of *words*.

[2] Raehlmann, "Physiologisch-psychologische Studien," etc., *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*, Vol. II, p. 53.

impressions is then at times completely reversed. The conduct of dogs, for example, shows that their memory must be one vast array of odorous detail. Sight, instead of playing the chief rôle, as with us, is with them subordinate, a mere rudimentary suggester of possible and coming scents. When they must depend solely upon the sight of things, they behave somewhat as we do in the dark.[1]

Variations in normal persons.

And even in what seem to be normal persons, great variations exist in the relative importance of sight and hearing in furnishing the means of recognition or recall. I have a friend who cannot recall or recognize a single simple melody, although his hearing has apparently the normal acuteness. The recollection for such things in his case is blank. He was confident that he could recognize *Dixie* (he was a Southerner), but we soon found that the rhythm alone was appreciated, and if other notes were thrown into the same cadence it seemed to him the familiar melody. Another friend has a vague sense of recognition when certain music is played but cannot "place" the com-

[1] This subordination of sight in the dog was impressed upon me afresh while watching recently a fine hunting dog try to trace his way under circumstances where smell could not give the usual clew. An electric car upon which his master was riding slowed up and the dog jumped off, while the car with the man aboard passed on. The dog, of course, found at once that his master was not with him. But instead of following the car, — which was on a clear street and not going faster than he could run, while the dog's owner was in plain view on the outside trying to get the dog's notice, — the dog set up a wild search for a ground scent, running up and down the track, and to and fro on a cross-street near by. This blind hunt lasted some time, until his master, who had alighted perhaps two hundred yards farther on, finally attracted the dog's attention by his call.

position unless it suggests words; through them alone the piece is fully recognized. Some persons can remember much better what they hear; others have more definite recollection of things they see. I know a lady who, after a single glance at an engraving never seen before, can answer questions as to minute details of the drawing that were not noticed in the short interval when the picture was shown. The answers are given by mentally recalling the picture and submitting it to an examination as if it were sensibly there. What the explanation of this difference of memory type is we do not know.

Practical value of the results.

Our modern psychology has thus done much to unfold the variations and oddities of memory. And such discoveries are not merely curious, but are also of practical importance, especially in the conduct of the schools. How many children have been accounted stupid simply because no one appreciated the peculiar difficulties under which they worked! They were expected to retain materials that had no affinity for their particular constitution. And their failure was counted a moral wrong, laid at the door of the will or of their inattention, when in reality the difficulty was not there at all. The present interest in child-study in the schools has already prepared the way for a more intelligent and sympathetic treatment of these personal differences. To a teacher interested in psychology, not as a bookish doctrine, but as a thing of flesh and blood, a child who cannot learn to spell should be regarded as a rare and inviting individual who may not be dismissed until he has yielded up the secret of his defective memory.

CHAPTER X

TEMPORAL SIGNS AND THE RANK OF MEMORY

So far we have confined our attention to the vividness and fidelity of our recollections and to the difference in these respects in different minds, and in the same minds when dealing with different materials. But there is another important feature which we have now to consider, namely the matter of *temporal signs*. In the chapter on the consciousness of space the question of local signs was considered — how we are able to distinguish the place in the outer world from which various messages come, and refer each to its appropriate locality. There is a similar problem in regard to memory. How are we able to refer our countless memories each to its proper region of the past? Each idea of the past is, while we remember it, a present mental act, and yet we somehow distinguish the various items, and with perfect security say that some are of recent events while others belong to the early years of childhood. What is there in these various memories that suggests to us the time-order in which we should arrange them; what, in other words, are their temporal signs?

How do we determine the date of impressions?

It would be gratifying to our laboratory and mechanical-science instinct if we could truthfully assert that it is all a matter of distinctness in the various

Is it according to their distinctness?

pictures, the more sharply outlined memories being adjudged to belong to more recent events, while the vaguer are felt to be of an earlier date. Distinctness of course is not the same as simple intensity. Very weak things — a whisper close to the ear — may be very distinct, while much louder tones coming from the next room may be obscure. The memories that are most definite, that have the most nicely marked details, would, according to this view, seem the more recent, while the obscurer ones would be referred to a remoter past.

But the vague is often felt to be recent.

Now while many of the facts would undoubtedly be consonant with this view, yet as a whole they will not sanction so simple a rule. The recollections that we know are but of yesterday are often more vague than others that we consciously refer to an earlier date. Most of us could give a more coherent account of last summer's outing than of what occurred at the last dinner we attended, or could recall more distinctly our reading of Gulliver than of yesterday's newspaper. And yet we make no confusion of relative dates. The experiences recalled more distinctly are nevertheless felt to belong to an earlier time. Distinctness consequently does not decide the order of memories.

No one formula suffices.

The basis of our decision here is exceedingly subtle and complex. It is like our judgment of the relative distances of objects from us: no one formula will fit all the facts. In determining relative distances from us in space, we are undoubtedly influenced by the intensity and distinctness and size of the objects, and by atmospheric and line perspective; and now one

and now another of these factors has the upper hand. And moreover the basis upon which we decide the relative distances of things in the foreground where binocular vision is effective, with its inequality in the pictures given by the two eyes, is entirely different from that in regard to objects far away. So, in ordering our memories, there are many temporal signs, and those that govern us in regard to recent events are not the same as for occurrences more remote. In memory there is a certain foreground where things stand out from each other in a kind of plastic relief, as in some temporal stereoscope, and we seem actually to perceive the time between them. The order in which we hold these recent events probably depends upon obscure gradations of emotion, or perhaps even of sensations which accompany the memory-images and suggest to us the time to which they belong. The distinctness of our memories may, indeed, be an important factor, although by no means all-important.

The temporal foreground.

But, after all, and especially when we try to interrelate events lying in the more distant past, our main dependence is upon our knowledge of how things *ought* to go together, rather than upon simple sensations or emotions or upon the element of distinctness. We learn some of the more elementary laws of nature and, guided by them, set up certain mnemonic landmarks; and then, with these, we connect our subordinate memories, knowing, as we do, what their causal relation was, and what order they *must* have had. The psychology of space will again furnish a useful parallel. A mountain is seen as lying beyond the distant

More remote experiences.

bay, not because the impression of bay and mountain are each accompanied by some immediate local sign that tells what their relative distance is, but because it would violate all our knowledge of nature to suppose that the mountain was really between us and the bay, and yet the bay visible. We should have to suppose that the mountain was transparent, or was floating unsupported in the air. Our appreciation of the orderliness of nature, our conviction of causal regularity, here decides the day. So in memory, the order of events is in most cases not decided by some different sensational or emotional sign attached to the various recollections, but by our conviction, based upon our knowledge of cause and effect, that any other arrangement would be an intellectual absurdity. I feel that a certain ocean voyage precedes a visit, say, to the city of Guatemala, because I know that, putting my life together as a whole, things will not fit one another in any other way. The circumstances were such that the voyage was, as the world goes, a precondition of my seeing the city at all. In the same way we refer our memories of childhood to a remoter past than those of youth, not by reason of their greater obscurity nor the different emotional tone which is undoubtedly connected with each, but because it is the natural order of life, of which we have become convinced. A feeling for the intelligibility of the memory-system as a whole — a sense of the impossibility of understanding our past unless its order be thus and so — largely influences us. A subtle intellectual fondness for certain arrangements rather than

Influence of logical motives.

others, due in part at least to our experience and training, is of more influence here than any purely quantitative guide. Since the memory-process is thus so interwoven with the judgment and the understanding (unreflective and unconscious though their operation may be), not to speak of its connection with the senses and the emotions, we must give up the belief that memory is a distinct and separate faculty. Our higher intellectual functions are part and parcel of it.

How can memory be fundamental?

But this seems to conflict with the abundant evidence that memory comes very early in the mental development. Emerson appears to be not far from the most modern teachings of Genetic Psychology when he says that memory is the fundamental faculty without which none other could exist; that it is the matrix or womb of all our higher powers.[1] But from the sketch just given of the various elements that contribute to its perfection, memory would seem to be too difficult and complex a thing to appear at the very dawn of life. So that we are now forced to ask what is the true rank of memory; what is its place and function in our growth?

It must be present in the lowest animals.

We are accustomed to use the word "memory" in quite different senses, and our answer to the question will depend upon the meaning which we choose. If we mean by it a mere persistence of influences from the past, memory is certainly the basis of all development whatever. Instead of being a late comer, there can be no growth without it. Unless

[1] Emerson, *Natural History of Intellect*, Boston, 1894, p. 63.

the creature could retain the marks of what it had endured, there would be no progress; it could make no gains, it would at each moment return to an absolute beginning. What we call experience, from which we are inclined to explain so many of our mental acts, is itself impossible unless there be retention. The bare impressions of the moment, stripped of all associations and suggestions springing from the past, could of course have no meaning. The feeling of the passage of time, the feeling that there are real things outside us, not to speak of our higher perception of law and order, are consequently dependent upon our power to keep at least something of what we have passed through. Memory in this sense may be traced down, almost, if not fully, to the bottom of the animal scale.

Mere persistence *vs.* conscious recall.

But we must distinguish between the mere persistence of influences from the past, and a conscious recall of the past. Memory, in the higher sense, is an exceedingly complicated act. In order to remember, in this strict sense, not only must we have had the past occurrence continue within us, but it must actually influence us to the point of arousing a present idea and of making us recognize this as standing for a past event. Imagery alone is undoubtedly a comparatively high achievement; but memory goes even farther, and makes the present images stand for a reality beyond them, which is past.[1]

[1] I am, of course, referring here only to the clearest and most explicit forms of recollection, which are of a very high order of development. That there are lower forms which are (relatively and, perhaps, absolutely) imageless, I have no doubt. Cf. note, p. 172.

Memory in the narrower sense comes late.

Now there is no good reason to believe that the lower forms of life ever consciously picture the past and recognize it as such, — ever recall preceding events and know them as belonging to an earlier date. Reminiscence implies a withdrawal from the storm and stress of life, a subordination of the present, and a comparatively unpractical interest in things — an interest that is the immediate precursor of art. For this reason Memory is indeed the Mother of the Muses.

Animals' dreams and their recognition of objects.

But in the mind of animals and very young children there is hardly anything approaching this free reminiscence. Perhaps the best illustration of what their state may be is found in certain aspects of our dream-consciousness. In spite of its fantastic character the dream-state is often exceedingly matter-of-fact and at the opposite pole from that of art. Imaginative though dreams may be, we are perhaps, while in them, usually in a practical frame of mind, absorbed in the affair of the moment, and without any desire to play with our ideas or impressions, or to connect them into a system of the past. And yet the past is of course the source from which the material of our dreams for the most part has actually come; but we fail to recognize it or refer it to its date. In this respect we all have something like a direct experience of the animal's plane of thought, so far as its mere attitude toward the past is concerned. Animals and babes make use of the past but without free recall. Their dreams, therefore, are no evidence of recollection in the higher sense. And moreover the recognition of places and

persons which dogs or horses display seems never to go so far as to excite an independent interest in recalling and organizing the suggestions which the object arouses; the mere feeling of familiarity itself satisfies them, and no questions are asked as to its cause or justification. It will not do, however, to be too positive in describing the mental life of animals, and one should always preserve a wholesome doubt as to the finality of his assertions here.

Memory and personal identity.

If so large a company of minds as the greater part of the entire animal kingdom and the younger members of the human family seem only to be influenced by the past, and not to be reminiscent, we can hardly say that memory in the higher sense is really a fundamental process. But while many persons would perhaps accept the notion that memory might be absent in the lower forms of life and consequently should not be regarded as fundamental in the sense in which the evolutionist would understand the word, yet they would hold that it is fundamental for us now as moral beings, since it is the basis of personal identity and continuity. Is not memory the only thing that keeps our consciousness from breaking up into numberless fragments ; the only thing that unites our scattered experiences into one continuous life? And if memory ever really loses its entire possessions, as it seems to do, in a large measure, in old age, and as many suppose it does, entirely, at death, would not this mean essentially the end of the particular person? Any renewal of experience thereafter would be, to all intents and purposes, the development of a new person, and not

in any real sense a continuation of the old. The question of the place of memory, and of our dependence on the actual contents which memory retains, is therefore a weighty one for our moral future.

The sources of personal continuity.

To a large extent the answer is prepared in what has already been said. I have tried to show that there is a development and growth in the lower forms of life which cannot be ascribed to a conscious reproduction of the past. In animals and young children their past is at work in them; their personal experience continues to affect them, even though not consciously recalled. To retain the advantage of what we have experienced and to keep it as a part of our personal life, it is not necessary to have it before us in reminiscence. Benefits forgot are not the same as benefits annulled. We need not remember our school-days in order to continue to profit by what they gave us. The first two years of childhood are as much a part of us in their lasting moral worth as any other years of our life. It seems a more vital matter that an individual or a nation should *have* a good history than that it should *review* its history. I cannot therefore attribute to conscious recall the all-important place that some would give it. A distinct and continuous life may have its growth and moral training without our being able to look back and examine the sources from which that life has flowed. Memory, then, is not the only thing that keeps consciousness from breaking into atoms, or that binds our life into a continuous whole.

But while conscious reminiscence is not absolutely indispensable for personal continuity, and while we

The influence of recollections upon conduct.

may suppose that interruptions of memory need not interrupt our intellectual and moral growth, is it not true that our conscious memories have an important influence upon conduct, and that to a large extent our moral stability would be upset by a loss or change of recollections? I think we must admit that to some extent this is true. The actual contents which memory presents influence our acts. We do good to those who have done good to us. We are all more or less influenced by the thought of consequences that have come from former deeds. We hesitate to do things that are inconsistent with pledges given. Remembered precedent is thus an important factor in private life as well as in law and politics. And yet, admitting the force of all this, we are apt to attribute much more influence to our memories as guides of conduct than they really have. They are relatively surface things, and less effectual than they seem. Beneath all is the great undercurrent of life carrying the memories themselves along, rather than guided by them. For instead of our being the slaves of what we recall, our character itself largely determines what shall be remembered and what we shall forget, and, most important of all, determines the weight or force which the past event shall possess. For there is no fixed and inherent force which a recollection exerts upon us irrespective of our deeper constitution. We ourselves, according to our affinities, lay stress on this or that particular item of the past and give it value and importance. In regard to precedents, there are really such for everything and anything you please, and we pick and choose

Their importance is often overestimated.

The scale of values is what counts.

the one that falls in with our dominant interests; so that the great interests of the individual or of the community determine what shall be the controlling precedent, or with what part of our history we shall act consistently. For a long time, as a people, we remembered our own struggle for self-government and the words of the Declaration of Independence, and it seemed that these memories were guiding our conduct toward our neighbors; but since the naval fight at Manila, what an altered weight these memories have received! It is not so much, then, what we remember, as it is the weight that we give to our recollections. The scale of values, after all, is what counts; and while memory to some extent determines what the scale shall be, yet to an incomparably larger extent it is fixed by inner dispositions and habits that need not be remembered at all, in that they have become bone of our bone and flesh of our flesh.

In due time memory is subordinated.

I think that from still another side memory may be seen to be less essential to moral development and personal continuity than we are usually inclined to admit. For with the growth of insight into the laws of the world, memory is being given a more and more subordinate place. We are indeed already in possession of a power which in many respects does the task of memory more effectually than memory itself. I have already spoken of the rôle that our knowledge of the order of nature plays in deciding the sequence and connection of our memories. But it really does more than that; it supplements and corrects memory in various ways. Men used to know only so much of the past as they could per-

sonally remember, or so much as was handed down by tradition — tradition being the corporate memory of society. But we have now gone beyond that point, and are able to know whether the tradition itself is right or wrong, and to see farther than its utmost reach. Science, working by insight into the laws of things, successfully reproduces the past in a more accurate and larger way than recollection. For example, by means of geology, we can recover periods of time long before man's life upon the earth.

Reconstruction of the past by insight.

There are thus two ways of reconstructing the past which are psychologically and in their practical results quite distinct: by memory, as a kind of mechanical association in which there is little need of understanding the why and wherefore of events, — evening knowledge, *cognitio vespertina*, as it has been called; and in contrast with this, there is the reconstruction by insight into the necessary nature of things, — morning knowledge, *cognitio matutina*, when passive memory is brushed aside, and fresh and vigorous intellect comes into play. As insight grows, memory becomes more and more subordinate; the present facts themselves reveal what must have been their history: we can thus see what they imply, much as an expert can glance at a thigh-bone, and tell what feet and jaws the beast possessed.

Even in the plain man, reason lords it over memory.

It may seem fanciful perhaps to speak of the time when this shall be a universal art; when the world shall be so transparent that we may forget all things without loss, because we can at will reproduce them, having become possessed of the secret formula of their construction. But that is at least the "limit"

toward which we are moving; and indeed we are already some distance on the way. The grasp of the facts by understanding rather than by memory is not confined to the *savant;* the plain man uses it in his own domain. Whatever our theoretical reverence for memory may be, none of us now pays great practical respect to it; what it tells, we accept half-heartedly and with suspicion, never fully believing it unless reason approves. I seem to recall that the facts were thus and so, and yet reject this and believe the opposite because from certain present evidences I know that the event must have been otherwise. In this way, reason lords it over memory, modifying and rejecting her work without reserve.

Memory is a transition expedient.

And yet it will not do to make the contrast too sharp, nor to suppose that memory can be entirely laid aside. For with us at present, memory is the necessary means of rising superior to memory. Our insight is not as yet sufficient to enable us to detect in our immediate and present perceptions a wide range of unperceived facts. So that we must depend upon memory to furnish the larger store of experience with which reason works. It is consequently through our power of recollection that we attain that preliminary familiarity with nature and its laws by which we are able later to turn upon memory, correct it, and even shake ourselves free from its dominion. The course of development, therefore, it seems probable, is from an initial state, in animals and children, which is without consciousness of the past, through a period of memory and recollection, and then onward toward a condition of even more perfect consciousness

of the past than memory gives; but by insight and not by mechanical retention. Memory thus stands between these extremes as a happy transition expedient, an easy makeshift, mercifully given us during the days of our ignorance, so that we may have the world before us without the need of understanding it. Some such thought seems intended by Beatrice when she says to Dante[1] that the angels have no need of memory, because there is no interruption of their vision; they see all things constantly reflected in the divine countenance.

[1] *Paradise*, Canto XXIX, ll. 80, 81.

CHAPTER XI

IMITATION AND SUGGESTION

The worth of imitation only recently recognized.

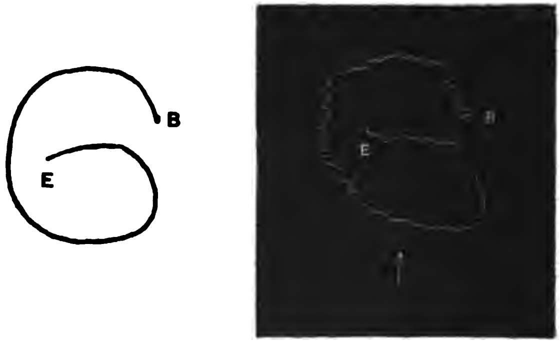
IT is a comparatively recent insight that imitation and suggestion are pervasive and significant facts. For a long time they were thought to be of minor importance, coming occasionally and having prominence only in persons of little original power. Imitation was counted a mark of immaturity, children and child-like creatures generally being almost the sole imitators; and to imitate is still, with many, accounted a cause for reproach.

But one of the great doctrinal gains of recent psychology has been the recognition that we are all imitative to the very heart; that imitation is not a mark of the few and of the weak, but is really a deep trait upon which we may, without exaggeration, say that society and morality itself depend. To Tarde in France, and to Baldwin and Royce in this country, we are chiefly indebted for the development of this important truth. And it is largely as a result of the interest they have aroused that at the present time one can hardly read a page of psychology without perceiving some appreciation of the rôle that imitation and suggestion play.

Its connection with suggestion.

Now why do we link imitation and suggestion in this way? It is because they actually do lie so close together that when you consider either one of them

you are inevitably led to view the other. Imitation, in fact, may well be counted a special form of suggestion. But this will come out more clearly when we have run over some examples of these processes, beginning with the simplest and most familiar forms. It will then also appear that even hypnotism is intimately connected with the processes just mentioned.



I II

FIG. 39.—I. General form of conductor's movement. II. The record of the subject's hand. *B* and *E* represent respectively the beginning and end of the movement. The arrow shows the direction of facing.

Examples of involuntary imitation.

Cases of deliberate and voluntary imitation are of much less psychological importance than are those of the opposite sort — the inevitable, involuntary falling into the ways of those about us, with which we are all familiar. In the laboratory we have a good illustration of involuntary repetition when another's move-

Tracings by the hand.

ment is intently observed. If a simple contrivance, something like a planchette, be arranged to write on smoked paper, we may obtain a record of the movement of one's hand as another traces before him the

outline of some figure. The record often shows that the observer's hand has roughly followed the movement which he was closely watching. In Fig. 39 the outline on the left gives the course taken by the conductor's hand in one such experiment, while the right-hand figure is taken from the record involuntarily made by the subject's hand while intently observing this movement. In this and the records below, *B* and

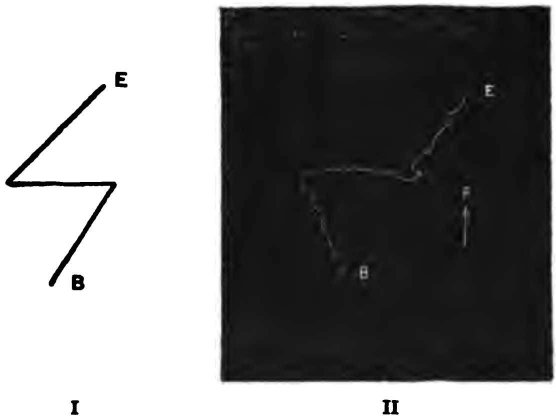
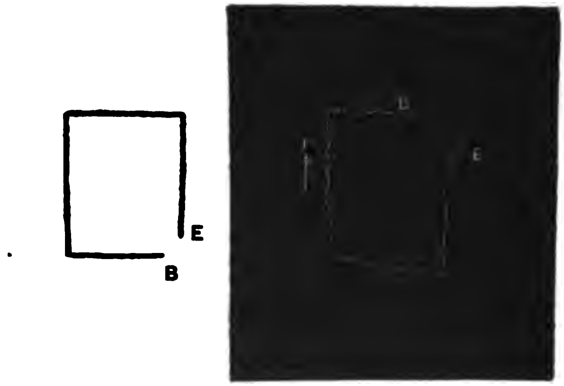


FIG. 40. — II shows a combination of direct and reversed imitation of the form in I.

E denote respectively the beginning and the end of the movement. Figures 40 and 41 give similar pairs showing an interesting variation; the conductor's movement is imitated partly in reverse order, while part of the figure is a direct imitation. Many of our acts that seem almost entirely mechanical or physiological — walking or laughing, for instance — are trained and modified by seeing how others do them.

Those who have heard the uncanny laughter of deaf mutes can appreciate what our own laughter would be like if it were not for the influence of social custom and good form. So tricks of speech or of gesture persist in certain families as if they were transmitted by direct inheritance, although, in fact, the children often come



I II

Fig. 41.—II, imitation of I, showing in part a direct and in part a reversed imitation.

How the sensible pattern affects us.

by them merely through imitating their parents and one another. Now in all those acts which we most readily recognize as imitative, it is obvious that somebody's manner or behavior induces the like behavior in us. And the way in which the one person affects the other is, in its broader outlines at least, clear enough; it is not by some immediate physical control that I am influenced, but only because some action attracts my attention so that I become conscious of it, and becoming conscious of it, I find that I invol-

untarily do the same. In all such cases an actual physical pattern is furnished, and the observer proceeds to copy it.

A sensible pattern is not absolutely necessary.

But a host of facts show that it is not always necessary to have a pattern sensibly before us. If an idea of an action can by any other means be kept clearly before one, his conduct will be influenced by it quite as well as if it were not a mere idea but were somebody's real action. Several psychological experiments illustrate this. If a person be made to stand erect under a blackened plate of glass or sheet of paper, and a wire point or sharp piece of wood be attached to his head so that it will quietly scratch this blackened surface, the swaying of his body will be recorded, and even when he tries to stand motionless, an intricate, irregular line will be formed, in appearance not unlike the mark left on an earthquake recorder. An example of such a record appears in Fig. 42, where the arrow marked *F* gives the direction in which the subject was facing. Now the form of this line is different under different mental conditions, and it is generally observed that there is a tendency to movement in the direction of the object which for the moment may be claiming the subject's attention. If we ask him to think intently upon something which he knows to be at his left, his whole body

Illustrative experiments.

FIG. 42. — Record with subject standing under a smoked plate.

begins to sway toward that side. In Figs. 43 and 44 the part of the record up to the point marked by the small arrow shows the normal movement without any

FIG. 43.—The effect of attention to an object in the direction *E*.

special direction of attention. The subject, whose eyes were all the while closed, was then told to think of some designated object in the direction of *E*;

FIG. 44.—Effect of attention to an object in the opposite direction from that in Fig. 43.

the immediate change in the record shows the result. And not only is the body as a whole thus influenced by the direction of attention, but similar results

are obtained when we experiment with movements merely of the arm or hand. All of this has long been known from the experiments of Professor Jastrow working with his recorder called an "automatograph."[1] Faraday had years before arrived at somewhat similar results by his experiments on the phenomena of table-moving. He found that with the usual conditions under which these movements occur — that is, with a circle of persons having their hands on the table and intently thinking of its moving in a certain direction — each person involuntarily and unconsciously pushes it toward the goal. By means of an apparatus of levers, he demonstrated that a considerable physical force was really though unconsciously exerted.[2] At the present day we are familiar with something similar in those games which depend upon "muscle-reading," and which have sometimes been believed to illustrate the possibility of thought-transference. Most persons, if they really carry out the conditions of the game and vividly picture to themselves the object that is to be found, will give muscular signs that are unmistakable to one practised in such things. The "thinker" either urges his companion gently in the right direction, or else gives negative signs — withholds his companion from the right place, in his very eagerness not to betray the locality selected; and this check is, when understood, as good a clew as

Bearing on table-tipping and mind-reading.

[1] Cf. the chapter entitled "A Study of Involuntary Movements," in his *Fact and Fable in Psychology*, Boston, 1900, p. 397.

[2] Faraday, "Experimental Investigation of Table-moving," *Athenæum*, July 2, 1853, cited by Scripture, *The New Psychology*, New York, 1897, p. 253.

is needed. And even in those cases where there is no direct contact and consequently no possibility of muscle-reading in the ordinary sense, there are signs of another sort. The recent experiments of two Danish investigators, Hansen and Lehmann,[1] go to show that much of the alleged transfer of thoughts might be accounted for by hints and suggestions given, for instance, by changes in the mere breathing of the person who wishes to impress his thought upon another. All this indicates how responsive the body is to the mental state. The mere idea of an act starts a chain of nervous processes that finally make the action real. Something that the person is thinking of suggests the peculiar response. The behavior is then the result of suggestion. In imitation in its commoner sense[2] there is much the same process; the only difference is that the pattern is not originated from within. The suggestion in such cases is simply more external and less an inner product of our own.

The body is responsive to our mental states.

But why does it not respond in all cases?

But if it be true, as has been thought, that ideas pass over so readily into movements and thus tend to be actualized, why do we not do all things whatsoever that occur to us? One of our constant sources of regret is the inefficiency of so many of our good intentions, and, on the other hand, we happily do not actually perform all the foolish things of which we think. In many instances of this kind, however, there

[1] "Ueber unwillkürliches Flüstern," *Philosophische Studien*, Vol. XI, p. 471.

[2] Both Baldwin and Royce, as is well known, use the term "imitation" to include much more than this.

is nothing to make us doubt the original proposition that anything which suggests to us the thought of an action tends thereby to bring on the very act itself. When the thought remains without its proper result, it is usually not because there is no power in it, but rather because its inherent force has been offset by an equal or greater force in the opposite direction. The act does not take place, because along with the thought of it there comes the notion of the contrary action. And since both ideas tend to realization, and yet both cannot be realized at the same time, they produce a deadlock, and apparent passivity is the result.

Importance of competition and choice among ideas.

In this way checks are brought about, and the development of such checks is an exceedingly important thing. If it were not for the free and immediate rise of contrary suggestions, we should be the prey of the first idea that occurred to us. So the arrival of contrary suggestions prevents headlong mechanical action, and gives us time to summon our wider experience and make it play upon the problem of the moment, and action becomes deliberate rather than impulsive. It seems to me erroneous to describe the result as a victory of one idea over another; they do not fight it out among themselves, the stronger vanquishing the weaker. They are, rather, both candidates for an alliance with the will. There is something like a selection by us from the various suggestions that arise; we cast our volitional force on the side of one of them, and action in keeping with it takes place.

A healthy mental life requires that there should be

a free rise of antithetic ideas, and that we should prefer and emphasize the idea which seems suitable. But in some persons these safeguards are wanting. The first idea presented brings with it no opponents, or, if accompanied at all, it has only harmonious associates, and these have free play. Such persons are impulsive, unhesitating, unreflecting. They are often most efficient; but much depends upon the kind of ideas first in the field. If good ideas come first, the absence of hesitation is a gain; but if the ideas that arise are unfit, then the impulsiveness results in loss. The difficulty in the case of impulsive persons is, that the teachings of experience often obtain no hearing at all.

Connection of impulsiveness with hypnotism.

It is but a short step from such common and normal states as these to phenomena which at first appear to offer nothing but disconnection and contrast with our ordinary consciousness. The various experiments in hypnotism show, on an exaggerated scale, much that is already familiar in impulsive persons. In the hypnotized person there is a narrowing of the field of consciousness, so that, for the most part, all ideas are excluded except such as are in harmony with what the operator calls up by his words or signs; and the action of the person, because spontaneous contrary suggestions are checked, falls into accord with what has taken possession of his mind. He has only to be told that he is General Washington or Frederick the Great, and a more or less clever impersonation results. The ideas here, as in a simple impulsive or imitative action, work themselves out,

unopposed, into acts. The peculiarity of the hypnotic state is that it shows the operation of suggestion in such a marked degree; and, moreover, the ideas from which the action springs are usually induced from without, instead of arising spontaneously from the subject's own character, as is often the case with impulse. There is established a strange *rapport* between two persons, so that the suggestions offered by the hypnotizer take precedence of all others, and whatever spontaneity there is in the patient is merely, as it were, a spontaneous assistance, a ready filling-in of the bare outlines offered by the person in control. The action itself, when once the ideas are aroused, flows off unhindered according to the general law of mind, that all ideas, unless positively checked, tend to be expressed in action. The ordinary counter-suggestions — the doubts, the self-consciousness, the thought of the incongruity of the situation, all that usually makes it impossible for us in normal life to enact whatever occurs to us — these are in some way kept under in hypnotism, and the one isolated group of ideas comes to full expression. But this is only an exaggerated form of what occurs in ordinary imitation or suggestion. In these cases, too, an idea has forced its way to the centre of attention, and, excluding all rivals, makes us act it out. At bottom, then, suggestion and imitation and the main facts of hypnotism are all one. The person whom we involuntarily imitate is one who, to some extent, has hypnotized us. Something in his bearing or character puts us in touch with him; he captures our attention, and before we know it, we are repeating his acts or manner. In the case of imitation,

Hypnotism is at bottom a form of suggestion or imitation.

the suggestion is offered by another person's conduct; in hypnotism it is more by word of mouth. But the mere difference of mode of introducing the effective idea into the mind of the subject is a minor matter; in the more essential features — that one person can arouse an idea of an action in another and have it expressed in conduct — hypnotism and imitation are one. Suggestion or imitation may, with this understanding, be used as a convenient term for the whole group of occurrences.

Analogies between hypnotic and normal action.

But I cannot drop the subject of hypnotism without some further illustration of its kinship with our normal behavior. "I hypnotized Mr. J. F.," writes a recent contributor on the subject; "with one resolute command I made him cataleptic. 'Rise,' I commanded him. He rose. 'Walk'; he walked. 'You cannot walk forward.' He tried to walk, but could not. 'You can only walk backward.' He began to walk backward."[1] But this is only an extreme form of what we are all experiencing every day. The same writer found that, without hypnotizing his men at all, they would carry out in a more or less direct and mechanical fashion his simple commands. And so it is in the larger world: some men have the power to make their companions feel themselves capable or incapable of certain things, and the assurance brings about its own fulfilment. In many cases, men need only to believe that they can do a thing, and they can; if they believe they cannot, the act then becomes impossible for them, — a truth which Professor James

[1] Sidis, *The Psychology of Suggestion*, New York, 1898, p. 12. For his instances of suggestion without hypnotism, *vide ibid.*, p. 35.

has turned to such striking account in his remarkable essay, *The Will to Believe.*[1]

Even those curious phenomena of post-hypnotic suggestion, which to many seem absolutely unique and unprecedented, have their analogies in states of mind in which there is no sign of the ordinary hypnotic influence. The hypnotized person is told that he is soon to be awakened, and thereafter, at a given sign, he is to perform some specified act — open the window or walk around his chair. The person is awakened, and when the occasion comes, although he is unable to give any clear reason why he should do so, he carries out the suggestion. He finds it more comfortable to do it than to resist the impulse. Something like this we are all familiar with, though luckily it comes but rarely and then only in regard to the more trifling things of life. When tired or nervous we may be reasonably certain that our door is locked, and yet can get no peace of mind until we have satisfied ourselves once more by actual trial. Or the phrases *Heldenmoral* and *Sklavenmoral* flit through our mind, and although we are not at the moment interested the least in literature or ethics, but wish most of all to fall asleep, still the insistent question, Who has written of such things? is there, and we must finally, protesting all the while, think up the name of Nietsche. Here the performance of a certain act — the recalling of the author's name or going to the door — is somehow given a force that is out of all keeping with

Post-hypnotic suggestion

similar to insistent impulses and ideas.

[1] In his *The Will to Believe and Other Essays in Popular Philosophy*, New York, 1898.

the value or reasonableness of the act itself. We cannot justify our obedience to the suggestion on any ground except that it is not worth while to keep up the struggle; that the quickest and simplest way to regain tranquillity is to yield and have done with it. It was evidently something of this kind that compelled Dr. Johnson, as Boswell tells us, to touch each post as he passed it on the street; and if by chance he missed one, he must return and tap it before he could proceed.[1] We cannot in all cases say why an idea can gain such prominence; in some instances, the very odiousness of the suggested act, however, draws our attention to it, and our efforts to banish it, but fix it more firmly in the mind. Thus we see that also in this class of acts, where the performance does not result simply because there is no opposition to it, as in so many cases of hypnotism and of impulse, but because of the burr-like tenacity of some idea which refuses to be dropped until it has worked its way through — this abnormal kind of suggestion, too, is merely an extreme case of what is going on in our minds daily, but which, by its very familiarity, ceases any longer to attract much attention. Even the actual physical changes which are sometimes produced by suggestion, — blisters or scars, for example, by touching the skin with some innocent object, like smooth glass, with the remark

The physical effects of suggestion have analogues in normal life.

[1] For other authorities and details in Johnson's case and for a number of similar and most striking instances coming under his personal observation, see Dr. Hack Tuke's "Zwangvorstellungen ohne Wahnideen," *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*, Vol. II (1891), p. 95.

that it is glowing hot,[1] — even these are not without parallels on a small scale in relatively normal states of mind. We can make our skin tingle by fixing our attention upon some portion of it; and sickness is often brought on by one's very concern for his health.

Suggestion is not exclusively a motor affair.

Returning now to our normal life, it might seem as if imitation and suggestion had only to do with physical acts — movements of hands or feet, or variations of speech. But this is by no means true. Numerous observations and experiments show that our more inner mental life is fully as subject to the effects of imitation or suggestion as are these involuntary movements of the body. Half of what we see and hear never comes in through our senses at all, but is made up outright — suggested by scraps and hints that do come in through our eyes and ears. In a foreign land, when the mind is not so ready to fill in all the gaps in the unfamiliar language we hear, one begins to appreciate how largely in our mother-tongue the mere act of catching the sound of the words, not to say their meaning, is a matter of suggestion. And in other ways we can see that as soon as things grow familiar and suggestive, it is impossible ever to experience them again in their naked reality; what the bare sense-impressions call up to us becomes interwoven with them, and these additions can with difficulty be distinguished from what is original. Thus, without experiment, we should hardly expect that the consciousness of the

Its part in sense-perception,

***e.g.* in visual depth.**

[1] Krafft-Ebing, *op. cit.*, pp. 28 *et seq.*

different distances at which objects lie from us is not as immediately "given" as are the very colors or shadows of these things. And yet it is not; this depth effect is our own construction suggested by the distribution of light and shade, the direction of lines, and, also, by the sensations of strain and movement in the eyes. The "tactile values" in painting, (as Berenson well calls them), and in all our visual experience, is thus a matter of suggestion.

Modification and suppression of sensations.

But, beyond the mere spatial qualities, the very stuff of our sensations is, by a kind of mild hypnotic influence, altered or suppressed. It took centuries for artists to see that the shadow on a colored surface was not a darker tone of the same color, but had usually something in it of the complementary hue. The natural preconception as to what the color of the surface ought to look like, from having seen it in a clearer light, made it impossible to see the thing aright. The imaginative filling-in of the "blind-spot," which exists for all of us in the field of view of the single eye, shows the same tendency. And Tawney by his experiments on the sense of touch[1] has brought out the enormous change that will be produced in the apparent sensibility of the skin when one is led to expect that the sensibility will change. So, too, if letters or figures be very briefly exposed to our view, it is impossible for one to say how much of them he has really seen and how much he has imagined. What, in truth, he does see gives some bent, starts the process of sug-

[1] Tawney, "Ueber die Wahrnehmung zweier Punkte," etc., *Philosophische Studien*, Vol. XIII, p. 163.

gestion, and either adds to the original sense-impression, or alters it, often in some most surprising way. If one try his best to copy a simple figure that is exposed but an instant, aiming to put down nothing that is not assuredly observed, it is astonishing how much will be seen that is entirely at variance with the figure as it really is. The accompanying drawings (Fig. 45) give some hint of the results of this process of subjective distortion, the first column giving the originals that were actually shown, while the others are the careful drawings of what various people felt sure they saw.[1] Most illusions, also, are illustrations of this trait of adding in items subjectively at the instigation of custom. The impossibility of distinguishing fact and fancy by any difference of vividness or of sense of reality is what makes human testimony upon matters of fact so untrustworthy and so much in need of sifting and control. Every judge and every juryman should take a course in the psychological laboratory to appreciate this fully. Experience gives us our twists and prejudices, and under its

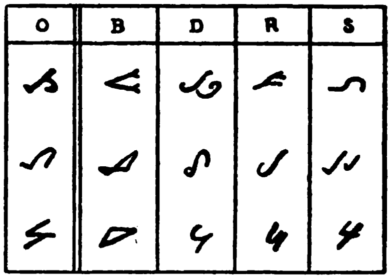


FIG. 45. — Column *O* gives original figures very briefly shown. The other columns show how these appeared to different observers.

[1] From unpublished experiments by Mr. F. G. Athearn in the laboratory of the University of California.

moulding power the outer impressions take on various forms. With all of us it is as it may have been with Polonius when Hamlet questioned him:—

"*Hamlet.* Do you see yonder cloud, that's almost in shape of a camel?

Polonius. By the mass, and 'tis like a camel, indeed.

Ham. Methinks, it is like a weasel.

Pol. It is back'd like a weasel.

Ham. Or, like a whale?

Pol. Very like a whale."

Suggestion may determine our preferences.

But it is not in altering the play of our perceptions merely that suggestion makes itself felt. We find that our deeper processes, too, are under its control. Our momentary interest, our sense of the relative value of things, is largely a gregarious matter; it is induced in us by the persons who form our society. On a small scale the phenomenon is illustrated by the effect which a single person gazing intently in a shop-window will have upon the passers-by, especially in a foreign city, where doubtless some oddities of dress or manner heighten his suggestive influence; you may select the most unpromising and commonplace display of goods, and very soon have quite a gathering of persons all interested in the sight. It is not that they wish to solve the merely intellectual problem of what it is that you find interesting there; your own attitude is catching, is involuntarily imitated, and excites its appropriate mental state in them. The prevalence of styles in dress, that, when the spell is off, look like an invention of the feeble-minded, illustrates the same fact. And probably the effec-

tiveness of ordinary commercial advertisements lies less in the fact that they add to our knowledge about certain goods than that they simulate the voice of a wide circle of persons all interested in that particular ware and commending it; and when throughout the community we seem to find such warm approval, we ourselves look with less distrust at the article offered and finally come to be among the buyers. Advertisements are effective because they produce an illusion of social approval. We are all subject, more or less, to the influence of "movements" or fads. Some become interested thereby in Japanese woodcuts, while others take to the study of sociology or Buddhism; but whatever may be its form, it is an induced interest, and a state of mind that would be impossible were we not subject to contagion from those about us. The action of a mob that performs deeds that any solitary member would shrink from, is but the last and fiercest development of the influence which suggestion may have upon the single individual.

Nor is its effect always transitory.

But the mental effect of suggestion or imitation is by no means always transitory, nor has it chiefly to do with our hurried interests and inclinations. Our cool judgment, our taste, our affections, are permanently altered in this way.

Its rôle in personal development;

Through imitation, we each come to possess much of what humanity has accumulated. Not only does the child obtain largely through imitation the power of speech, with all the store of conceptions which that implies, but his preferences and interests, which make it possible for him in later life to work with his fellows, are gradually influenced by the constant presence of like prefer-

ences in his society. The interest of his parents in him is, as Professor Baldwin has lately shown, one of the main sources of the child's consciousness of himself. The process here is but a more important case of what we have, in a trivial way, in the shop-window experience already referred to. The interest of others excites our interest in the same thing; so the child begins to take account of himself largely by marking the attention with which the circle of the family regard him. He *must* take notice of that centre to which their eyes are so constantly directed. His further education is very much a matter of example, which is but another way of saying that it

in teaching; is mainly guided by imitation. The teacher's most searching work consequently lies in furnishing a pattern of right interests and right appreciation of things, so that like attitudes of mind shall be stimulated in the child. Much of our respect for men comes because

in morality. we see that others respect them, and this proper recognition of their presence is one of the foundations of morality and religion. The teacher may possess most approved pedagogical devices, and be thoroughly master of the subject to be taught; but if at bottom he be bored by his work, nothing will quite prevent the child from being insensibly affected in the same way. And, on the other hand, it is due to the direct contagion of states of mind that the enthusiast, ill-equipped and clumsy though he may be, is often so successful in dealing with the young. This immediate effect of personality is, too, the reason why, in spite of printing-presses and books, the world is not yet ready to abolish the pulpit or the professor's chair. Better things

than one hears from most of them are to be found on any shelf, and yet we rightly prefer the person to the book, because the words, reënforced by a living presence, arouse the imitative powers within us in a way that mere print can never do. There is much sound psychology in some of the old dogmas of the Catholic church which Protestants are often inclined to regard as empty formulas. The stress laid on the power of the church—on the efficacy of personal fellowship, in contrast with the supposed power of certain documents or impersonal doctrines—is in entire keeping with the modern perception of our dependence on example. The tradition must be personal rather than mechanical; there must be a spiritual laying on of hands. And again, our appreciation of the value of imitation makes one see what deep truth there is incrusted in another of their doctrines—that the goodness of the saints is available for others. Not only is it available, but whatever gain most of us make is by a kind of spiritual appropriation of what others have already attained. Through imitation the gains of one become a common possession, without loss to him who first made the gain; it is multiplied in those who avail themselves of it. But the facts themselves are even wider than the ecclesiastical doctrine; for the possibility of appropriating, through imitation, the attainments of another is not simply a matter of morals or religion, in their stricter limits; it runs through all our life, through all planes of our intellectual growth, and even down to our bodies themselves, into our very muscles and sinews. We should all be stronger of body if we could have only robust

Psychology and religious dogma.

associates, and few can stand, without physical loss, the constant presence of invalids.

The sinister aspect of imitation.

And this leads to the fact that there are two sides to imitation: the one beneficial, the other just the reverse. There is a fascination in evil acts that causes them, also, to be repeated, quite as truly as in those of the opposite kind. Indeed, at the present day, it is this dangerous aspect of suggestion that has popularly been most emphasized. Not only is it often thought that imitation leads men to reproduce the bad pattern quite as frequently as the good, but the very fact that anything, good though it be, has come about at the suggestion of another, is felt to take somewhat from its merit. It is a sign of weakness, of want of originating power; in so far as we are imitative we are dependent upon others and cannot guide them, but must be led. And so, too, in regard to hypnotism: the specialist is inclined to view it as a beneficial power, something to be used for the cure of the sick; but the more widespread attitude toward it is, rather, one of mistrust and alarm. The appearance of hypnotism, occasionally, in the courts and in tales like that of "Trilby" has hinted at the possibilities of evil in it. There are those who hold that, excepting perhaps the use of hypnotism in the cure of the body, its presence, whether for good or evil, is a disquieting thing; it shows that we are in the power of others, whereas the only way to be secure is to be entirely self-poised, after the manner of the ancient stoics.

For those who dislike the thought of dependence

upon others, there really is no comfort in the universal influence of imitation and suggestion. The present appreciation of their significance is decidedly against the stoic ideal of a soul perfectly self-centred, and also against the somewhat similar Romantic ideal of a free and wayward personality developing entirely from within, taking no cue or hint from those about him. In laying stress upon the imitative function, our modern psychology is really furnishing excellent support for a socialistic, rather than an individualistic, view of man. The doctrine of Leibnitz, in which each monad is shut off from influences from without, developed solely by an inner force, mirroring the universe, but standing in no vital relation to the other members of the system — all this is certainly unpsychological according to our present light. Whether we prefer it or not, there can be no doubt that in our mental, as in our physical life there is no possibility of isolation and solitary development. From our fellows, we receive both good and evil; our fate to a large extent is in their hands.

From our fellows we receive both good and evil.

In many ways, indeed, this recognition of the essentially social character of man, which is thus reënforced by psychology, is a wholesome thing, even for our morals. To some the danger seems to lie in the fact that we are all the while discovering how little the individual is master of the situation, and how little, therefore, must be his responsibility. If in a certain sense we are all in the hypnotic power of our fellow-men, — if they do, in a degree, cast a spell over us and make us do their bidding, — I am not sure that the situation is one whit worse than in the

Responsibility is not thereby endangered.

older view, where each man was an independent unit, bound by no living tie to those about him. If my neighbor is not dependent upon me, and I cannot to some extent determine what his fate shall be, I can feel no responsibility for him. It is as we have found in politics: the only way to throw responsibility on any one is to give him power. The difficulty is that we are inclined to look at the dependence as existing in only one direction. We think of the mental life of the individual as swayed by the suggestions of his fellows, and overlook the fact that he, too, is a centre from which flows a counter quasi-hypnotic influence; he, too, is controlling them. His responsibility, which is in a way diminished when we regard him only as the recipient of influences, is restored when we see that he gives as well as takes; and that since he inevitably influences others, he must answer for the effect which he produces.

The servant is also lord.

Originality and imitation are inseparable.

So that imitation is, after all, but one side of the mental process. The other side is *origination*, which is quite as real and demonstrable as imitation itself. Imitation is a mere schoolmaster to bring us to originality. The child, through imitating others, becomes aware of his own capacity for a wide variety of acts that he otherwise would have believed were beyond his powers; he finds that he is able to do what others do. In this way, his own strength and skill and versatility are not only cultivated, but are revealed to himself. Imitation, then, even when we slavishly copy the acts of those near us, is all the while teaching us our own capacity. But even in the earliest

years we are never quite so slavish as we might believe. All patterns do not appeal to us with equal force. While it is true that the prototypes of most of the child's acts can be found in the conduct of those about him, yet it is also true that a great many things are done in his presence which he does not imitate at all; and this, of course, is especially true in later life. Our individuality is revealed in a sort of selection of the persons and kinds of behavior that shall have power over us. I do not mean that the selection is always voluntary, nor is it consciously worked out. But there is something in us that we cannot attribute to mere environment — an inner stamp or character that makes some persons have weight with us while the behavior of others takes no hold. We find our affinities, we make our choice of the various forms of conduct that are offered us. Thus with the same set of companions we find one particular child picking out whatever of mechanical skill he finds in the company. He immediately seizes on their power to construct steam-engines or to use tools, and whatever any of his fellows can do in this way he imitates and makes his own. Another boy gathers in from the same playmates an entirely different set of accomplishments; upon him, the machinery part of their interests makes no impression, but all suggestions they offer which tend toward the collecting of things affect him readily, and habits of accumulation and trade, rather than of invention and construction, are thus encouraged. No individual is absolutely plastic in the hands of his fellows; he soon shows his own grain.

Our selection of the pattern to be imitated.

Even the hypnotized subject reveals personal traits.

Even the hypnotized subject carries out some suggestions better than others. So that the individual is not a mere recipient, a transmitter of whatever influences come his way, but has within him a power which stands over against his environment and treats with it on equal terms, now aiding and heightening its particular influence, and now resisting the suggestions which it offers.

Originality even in following copy.

But the inner power of the individual is displayed not only in his choice of the various patterns that are presented to him for imitation, but also in his free treatment of the copy which finally counts. Very rarely do we find a literal repetition of what is offered. Even from the beginning there is a tendency to depart a little from the copy — to adapt it somewhat to the special circumstances and tastes of the individual; so that the replica always has a turn in it that the original did not have. The person, thus, in imitating, contributes something out of his own character; a novel element is introduced which strikes the attention of those about him; and, if it accords with their own natures, is repeated by them and further modified and supplemented. The very unexpectedness of it makes it a more fascinating thing and increases its power. So that the difference which we notice in the power of individuals to compel us to follow their example depends mainly on the difference in the amount of this originality which their acts reveal. So far as the individual is a mere puppet, his example counts for nothing. Imitation is thus always a recognition of original force and worth in the person who influences us; it is, as the

proverb says, the sincerest flattery. It springs from power, and is, therefore, not a sign merely that human nature is weak and plastic, but an indication as well that human nature has force and will.

The genius and his times. And of course the world is not divided into two classes, those who imitate and those who influence others. But, rather, each person, be he genius or be he dolt, is in some degree both imitator and pattern. In some things he allows others to lead the way; in some things he is an example to them. And even the genius is an imitator, while he is putting himself in possession of the accomplishments of his times; but having learned his trade in this way, he goes beyond his teachers. Genius, for this reason, does not produce isolated and unprecedented work, but comes as a culmination of much partially successful striving on the part of others working in the same line. They give him what they can, and he caps their work. He is, thus, neither the product of his times, nor is he independent of them. His general aim is more or less induced in him by his companions, and from them he learns his craftsmanship; but he finally outstrips them and sets a mark which the others are unable to surpass.

Man is at once the potter and the clay. There is, then, no real conflict between the imitative tendency and the desire to be a source of power. Only through the play of others upon us do we come into possession of our faculties. Imitation thus paves the way for its own destruction. It is a kind of go-cart in which the infant mind learns finally to walk alone. The knowledge of these psychological factors thus brings out clearly how social and yet

how personal a being man is; for even his originality is induced by others; and, still, his imitations are in a way his own. Only by his inner power can he ever be open to suggestions from others; a stone cannot be hypnotized. We must keep the two aspects of suggestion before us in due proportion. We must not think that the individual mind is mere clay in the hands of society. Nor, on the other hand, can we, when we fully understand the import of imitation, ever believe that society is an accidental thing, and that the individual grows solely by a force from within.

CHAPTER XII

THE ENJOYMENT OF SENSATIONS AND THEIR FORMS

Æsthetics *vs.* the psychology of beauty.

WHATEVER psychology may offer in regard to beauty must not be considered as competing in any way with the philosophy of art. The psychological work here has not the same aim that æsthetics has; it is concerned, first and foremost, with scientific explanations rather than with standards of judgment or appreciation. It is for æsthetics to define what art and beauty are, to determine what qualities a work shall have if it is to be counted a work of art; psychology is busied with a very different problem,—how it is that things of beauty produce their pleasurable effect.

General character of the work.

The psychology of the beautiful, then, remains far from some of the deepest problems of art. To one who is chiefly interested in this other—the philosophical—side, the experimental studies are apt to give as little satisfaction as would a chemist's report of the pigments used in the Sistine frescos, or a mineralogist's examination of the stone in the Victory of Samothrace. The psychological work is explanatory rather than appreciative, and, as yet, has to do with the bare rudiments of the artist's work—with such matters as symmetry and proportion,

with rhythm, harmony, and the like. And even in the experimental study of these, only a beginning has been made. But this beginning is interesting, and already gives indications of where the final truth will be found.

Why the experiments seem to slight the masterpieces of art.

It might seem at first sight that the experimental method could most profitably be applied directly to great products of art like the Elgin marbles or Bach's Passion Music. Why not set before a person a work of this kind and note the character of his "reaction"? Is not every artist, indeed, in some such way an experimenter in the realm of pleasure? In a sense, yes; but not within the scientific meaning of the word "experiment." For in scientific work it has been found that experiments are of value only in so far as the conditions of the experiments are relatively simple. One must not experiment with the universe in general, but must select from the confusing whole some single factor and discover what is its peculiar force. In any great work of art too many elements combine, and one cannot say how much of the total result is to be attributed to any one of them. The effect which the "Fates" of Phidias produces upon us is due not alone to the material used, and to the graceful curves which represent the figures and the drapery, but to the numberless suggestions which these arouse, — the times of Pericles, the Parthenon, and the placid Greek religion. And each of these factors again contains in reality a multitude of subordinate elements. So that it is impossible to deal in strict experimental fashion with objects which excite us in so many different ways.

Beauty must first be divided into its elements.

We must begin at the very beginning, with the very alphabet of beauty, and, if possible, gain some insight there into the nature of its effect upon us.

I. The materials of beauty:

Color

Beginning, then, with the simplest materials of beauty, it is found that with children colors have different emotional values even at an early age. It is not as yet entirely clear just what colors are most attractive to the infant; the results of experiments conflict, and probably, as with adults, there are individual differences.[1] But on the whole it is probable that the reds and yellows, which Goethe in his study of colors found so stimulating and which the savage so much enjoys, are also preferred by most babes. They react more promptly or strongly to these, or select them from among others. Blue and green, which, as mere impressions, are quite as marked, quite as vivid, in their way, as are red and yellow, evidently have not the charm for the primitive and childish nature that these warmer, sunnier hues possess. Their very association with warmth and vigor may in some degree contribute to this

[1] One of the sources of this conflict in experimental results is (in addition very likely to the personal equation of the babes) doubtless some lack of critical agreement as to the signs of color *preference* here. The mere power to name or to become attentive to a color, for example, has at times been taken as an indication that the color gave a peculiar pleasure. It could hardly be maintained, however, that a child's readier notice of a loud noise was proof that this sound was preferred to one of more moderate intensity. In the end, perhaps, the chief reliance will have to be upon the more subtle signs of enjoyment, on which Miss Shinn mainly depended. (See her "Notes on the Development of a Child," *University of California Studies*, Vol. I, pp. 33 and 50.)

effect; but doubtless the comparative rarity of the experience is an element in the case. Gold and red and yellow find the senses unjaded, since these colors are not constantly present; while the blue sky and the green foliage are always near. The preference in these cases is, however, not solely sensuous; it is not alone that the eye is unwearied by such tones; there is, besides, the intellectual stimulation, the interest, which uncommon things always give. The savage and the child seem, also, to prefer the saturated and unmixed color, while we in our art incline to some softening and breaking of hues, — for instance, blue with the faintest tinge of red or yellow, — partly, perhaps, from a desire to imitate the colors of nature, which are never pure, but partly, it may be, to make the color less easily classed, more problematical, so that it may better hold the attention. The color in tapestries, the mellowness of the old masters of painting, gives pleasure of this kind.[1]

Musical tones.

In a similar way the purest sounds are not the ones most used in music. The tuning-fork, after the first noise of the stroke is past, gives a tone like a pure color of the spectrum; it is well-nigh absolutely unmixed. The absence of this kind of tone from our music may be due in part to mechanical difficulties in avoiding the initial harshness when the tone is struck, or to the impossibility of easily varying

[1] Professor Jastrow, from results obtained at the Chicago World's Fair, finds that men, in their color preference, run to blue, women to red. Among children, blue is far less acceptable than pink. "The Popular Æsthetics of Color," *Popular Science Monthly*, Vol. L, p. 361.

its time and strength, but there are probably deeper reasons as well. For the flute, which also gives a relatively simple and pure tone, seems characterless in the main. The tones that please us most — those of the human voice, the organ, the violin — are always tinged with other tones, have in them a shade of impurity, some dim suggestion of mere noise. But this foreign element never obtrudes itself; it never appears in its own behalf; it serves only as a kind of atmosphere to enrich what is seen through it. The note must interest, must baffle us somewhat, or we reject it as tame. So that even down in the simple sensations of sound as well as of color, the pleasure is due in part to the presence of something in contrast with the mere sensations — is due to the conjunction of sensation with (if we shall not be misled by the word) a "formal" element, as well. The simplest sensory part of art, its *materia prima*, already begins in this way to show faintly the marks that are so characteristic of the finished work, — the contrast of the materials, on the one hand, and, on the other, the order or form in which the materials are arranged.[1]

Faint signs of a union of sensation with a non-sensuous element.

[1] The scholastic distinction of "matter" and "form" that is so pronounced in this chapter, and, indeed, runs more or less throughout the entire book (although not always in these words), is not intended to imply that the two are separate or separable realities. The present writer sympathizes with the objection that has been made to the use of these terms, — that the two factors are interdependent, and that either alone is a sheer abstraction. But it is often of great practical service to distinguish things that are inseparable, and an abstraction is not necessarily a nonentity nor to be despised. Pure "matter" and pure "form" are two opposite limits (in a quasi-mathematical sense) between which a concrete reality may move, now *approaching* the one pole and

II. The elementary forms:

So much, then, for the more important of the lowest sensory *materials* of art. We must now pass over to the other side just mentioned, to the rudimentary *forms* that we find agreeable, more particularly to the space-forms, composed of line and surface, and to the time-forms, such as the rhythm of verse and of music.

1. Rhythm.

It is curious to note the craving of the mind for form of some kind; so that we are never satisfied with separate unorganized impressions. The multitude of stars, for instance, are not left as disconnected points of light, but are soon grouped by us into constellations marked off by imaginary boundaries. In this way they become mentally more friendly and manageable. The very same thing goes on in the totally different region of sound. I have already referred to the fact that a succession of sounds of the same general kind will almost inevitably be broken up mentally into groups, and that each group has a certain organization, some of its members being subordinate, while others are brought to the front.

Imaginary rhythm.

If the sequence of sounds is reasonably uniform and monotonous, as with the metronome or the regular throbbing of a steam-engine, the sounds (as has already been brought out)[1] soon take on a fanciful rhythm, and each measure or "bar" of the rhythm

now the other, but neither of these limits can it actually reach. The two are thus necessary and inseparable aspects of all reality, whose mutual proportions, however, may vary indefinitely (like the two abstractions, surface and volume, of things physical), but never to the exclusion of either one of the pair.

[1] *Vide* p. 99.

has a duration corresponding to what we might call the normal pulse of consciousness, which lasts not far from 1 to 1.5 seconds. If a measure in this monotonous material is to be pleasing, it must take up about this same absolute time of 1 to 1.5 seconds, no matter how many separate sounds it may contain.[1] A measure is a group of elements that can be held in a single span of attention; so that for a rhythm to be agreeable it must rise and fall at the rate at which this inner process of attention can easily go on. If a measure lasts too long, it is felt as a strain upon the attention; if it is too rapid, it seems restless and we weary in trying to keep pace with it.

Rate of pleasant rhythm.

At first sight it is not easy to reconcile these results with the actual facts of versification and music. If one repeat —

But the rhythms of poetry ought then to seem unpleasantly rapid.

> "Heard melodies are sweet, but those unheard
> Are sweeter; therefore, ye soft pipes, play on;
> Not to the sensual ear, but, more endear'd,
> Pipe to the spirit ditties of no tone."

it will be found that this takes, perhaps, about twelve seconds, and in this time we have covered twenty feet, or measures, according to the ordinary scansion. This would give less than two-thirds of a second for each foot, — in verse, too, which strikes us not as rapid, but as rather the reverse. If in the psychological rhythm, as it might be called, — the natural pulse of attention, spoken of above — the measure is a little over one second, it would seem that verses like these should strike us as hurried rather than as deliberate.

[1] Bolton, *American Journal of Psychology*, Vol. VI, p. 145.

The psychological measure is distinct from the metrical "foot."

The fact is, that the real mental measure in these verses does not coincide with the ordinary pentameter scansion at all, but proceeds in more deliberate fashion, having its divisions something like this, where the full lines show the points of more marked psychological division, the dotted lines the less decided boundaries: —

"Heard melodies are sweet, | but those unheard ⋮
Are sweeter; | therefore, ye soft pipes, ⋮ play on; |
Not to the sensual ear, | but, more endear'd, ⋮
Pipe to the spirit ⋮ ditties of no tone." |

Poetic rhythm then fits the laboratory time.

Here are nine measures, and, when read as before, over a second would fall to each. And thus the time of these important features of the rhythm corresponds fairly well with the wave-rate of attention.

So, too, in the verses: —

"She dwells with Beauty — Beauty that must die;
And joy, whose hand is ever at his lips
Bidding adieu; and aching Pleasure nigh,
Turning to poison while the bee-mouth sips:
Ay, in the very temple of Delight
Veil'd Melancholy has her sovran shrine."

We read them in perhaps seventeen seconds, and since there are six pentameter lines, there would be about a third of a second for each of the thirty feet if we assumed that there are as many mental pulses as there are verse-feet. But there are really not more than about twelve mental measures in these lines, so that each psychic foot has nearly a second and a half — a deliberate, unhurried rhythm.[1]

[1] Some time ago my colleagues, Dr. Noble and Mr. Hart (the latter now at Harvard University), kindly consented to make a wider range of measurements than those which I had made upon myself, and of

In more rapid verse, like —

"Shakespeare was of us, Milton was for us,
Burns, Shelley, were with us, — they watch from their graves!
He alone breaks from the van and the freemen,
He alone sinks to the rear and the slaves!"

which takes about twelve seconds, we have sixteen feet, according to strict metrical arrangement; yet there are only eight or ten points on which there is any real mental stress. These it would seem are the real units, and the scansion feet are but ripples on the larger waves. So that the length of each psychological measure here, too, is a little over a second on the average, and consequently not far from the pulse time of attention as the laboratory experiments determine it. In music, also, in all probability, a somewhat similar agreement would be found, if we measure, not by the artificial bar divisions, but by the actual stretches of mental interest — the "phrases" (or in the slower *Choral* music, even the single notes), which are the more natural units that give the compo-

The same doctrine probably applies to music.

which examples are given in the text. With quite a variety of composition (verse and prose) they found a fairly constant rate of psychological measure for each of their three subjects, whatever the form of composition might be, although among the subjects themselves there was considerable variation. In summary they found: —

Subject	H.	N.	A.
Average time of a single measure, in seconds	1.73	1.22	1.45
Mean variation (per cent)	14.	6.	12.

For all three subjects the average measure was thus 1.47 sec., and the average variation 11 per cent.

sition its psychological rhythm. The satisfaction which rhythm gives is, at least in part, due, then, to the existence of a natural pulsation in our mental life, and the rate of this psychic pulse roughly determines the rate at which pleasing rhythm may occur in art.[1]

[1] Since the above was written, there has appeared the elaborate phonographic research by Mr. J. E. Wallace Wallin on the "Rhythm of Speech," in the *Studies from the Yale Psychological Laboratory*, Vol. IX (1901). Mr. Wallin, too, finds a certain approximation between some of the larger rhythms of speech (especially of poetry) and the normal attention-rhythm. But the rhythm on which he lays most stress has as its unit the *verse*, or line (average duration 2.69 sec.; but where the rhythmic effect is most marked, average 1.67 sec., — these being in each case the net time, *i.e.* the time left after subtracting the pauses between lines). This 1.67 sec. verse-group, he feels, tallies fairly well with the normal attention-time. Less important for him is the shorter unit, called an "expiration group," and marked off by breathing pauses which do not necessarily correspond with the termination of a line. This unit he finds on the average to be of 1.19 sec. duration (again omitting the silent time between the units) and shorter than the psychological rhythm, and therefore difficult to identify with it.

It seems to me that in this "expiration group," rather than in the "verse-group," Mr. Wallin is closest to the psychological heart of the matter. But even here we have not as yet the real basis of the mental measure, as I conceive it, but only one element in it. *The silent interval between his "groups"* (average 0.44 sec., as Mr. Wallin gives it) seems to me an integral part of the rhythm, corresponding to the trough of the psychological wave; and were this added, we should have a time (average 1.63 sec.) which is not far from the attention-pulse as we know it. The most significant thing in comparing the rate of verse-rhythm with the attention-rhythm is the time from crest to crest in each case, and not simply the average duration of the crests themselves, as in Mr. Wallin's "groups." With this change of interpretation, Mr. Wallin's results, I feel, are quite in support of the view offered in the text. His "expiration group," plus the silent interval, would correspond to my "psychological divisions of the verse," and his measurements (with this correction) are roughly in accord with what I there give, and are undoubtedly much more accurate and reliable.

2. Pleasure in space-arrangements: a. The simple line.

In contrast with the pleasure of rhythm which is present in poetry, in music, and in the dance, there is the gratification which comes from space-arrangements. The satisfaction which we take in a beautiful curve, or even in a delicately drawn straight line, has by many been supposed to be not a pleasure in the form itself, but in the quality of the *sensations* which accompany our perception of the form. The eye, in following a graceful curve, these theorists hold, has an ease of movement, an enjoyable muscular activity, which an irregularly broken line does not give. The muscular sensations are here supposed to be the pleasant thing, while the form itself is not enjoyable except indirectly as a stimulus to pleasant muscular feelings. This view, of course, would reduce the enjoyment of form to a sensuous pleasure, to a pleasure in the bare muscular sensations which enter into the experience, rather than to an enjoyment of the real form of the impression.

The muscular sensation theory.

Evidence that our enjoyment is not from the eye-muscles.

It seems to me that the satisfaction which we take in lines is not to be so easily explained. Mere ease of movement of the eye — the muscular sensation itself — is perhaps a factor in the pleasure, but a subordinate factor at best. In the first place, the movements of the eye, unless they become of considerable range or rapidity, are scarcely noticed at all, as can be readily shown by watching a single dim reflection of light on the wall of a dark room. Even when this light is motionless, it will often seem to move, since the movements of our eyes unnoticed by us are taken to be movements of the light. If we were so sensitive to muscular changes in the eye as some believe,

we should attribute the movement, not to the light, but to our eyes. In the second place, if we close our eyes and roll them, the movements they make, easy though they be, are either absolutely pleasureless or are infinitely less satisfactory than the artistic lines we so much enjoy. And, finally, if we watch the actual movements which another's eye makes as he looks at a line, say, like that in Fig. 46, it will be at once noticed that his eye itself makes no easy and graceful sweep along the contour, but moves in a rapid, jerky course from point to point.

FIG. 46.

Photographic records of the eye's behavior.

A mechanical record of the path the eye takes in looking at such a curve has an unexpected appearance. A sample of such a record is given in Fig. 47, obtained by placing a camera so that it would catch the tiny image of an arc-light mirrored in the front surface (the cornea) of the eye as an observer swept his glance along the curve shown in Fig. 46. The heavier dots of the record show the momentary pauses in the eye's motion, the lighter lines giving its course as it leaped from point to point. It is thus seen that the eye runs a wild course, missing the line, darting back on it again, moving now in straight lines, and now in curves even more complicated than the line it is telling us of. The eye's own motion is therefore entirely different

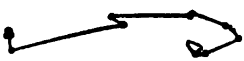


FIG. 47. — Characteristic record of the eye's path in following the curve in Fig. 46, from left to right.

from the form it reports. If we substitute for the curve in Fig. 46 an ugly variant (Fig. 48), the path taken by the eye is not enough different to account for the difference of our feeling towards the line (see Fig. 49); all of which goes to show that the muscular-sensation theory of linear grace is utterly untenable. Our æsthetic feeling toward visual forms cannot be explained as an appreciation of the muscular sensations which such forms arouse.[1]

FIG. 48. — An ugly variant of Fig. 46.

Why we enjoy certain lines.

Why a particular form of line should be pleasing, is doubtless due to a combination of factors, — to a curious mixture of pleasurable feelings connected with intellectual, sympathetic, and volitional processes. In the first place a regular line is more easily grasped, requires less effort of attention. Its course throughout is in keeping with what any limited portion of the line suggests, and thus the mental process of conceiving or of understanding the character of the line is easier and more agreeable. If there is some surprise as we pass along a graceful line, it is not a violent surprise, not a shock. The ugly line, however, does not follow any simple law; the sight of a single

FIG. 49. — Characteristic record of the eye's path in following the curve in Fig. 47.

[1] A fuller account and discussion of these experiments and their results appears in my contribution to the *Wundt Festschrift*, Leipzig, 1902, Vol. II, p. 336.

portion does not give us the key to the whole; and for this reason it does not appear to hold together. Its different parts require special and disconnected processes of attention, and so the whole gives an impression of strain and lawlessness. But besides the greater ease in mentally grasping a graceful line because its parts can be brought under some single law or formula, its character is such as to call out a kind of sympathy that no ugly line invites. Graceful lines are by experience often found to be the expression of movements that are under perfect control, or in which there is no suggestion of insuperable checks and hindrances. The evolutions of the skater, the flight of birds, the movements of a hand so trained that it absolutely obeys the will, give us impressions of this character. So that the lines that please us are those that suggest, though perhaps very dimly, a life that is master of the situation. Such life we sympathize with; it is, in a way, what we are all striving to attain; we dislike anything that suggests defeat or failure to cope with circumstances. And what we sympathize with we imitate. We often feel ourselves vaguely participating in the movement suggested by pleasing curves; we go through them ourselves, making at least incipient movements like those represented in the line. The imitative participation in what we already take pleasure in of course heightens the pleasure, while a similar participation in movements that are unattractive increases the disagreeable impression. The pleasurable imitation, the associations that make us

sympathetic with what a graceful line suggests, the lessened tax such lines make upon the attention — so much, at least, enters into our enjoyment even of these simple forms. Our pleasure consequently does not come from mere muscular ease or the absence of sensuous fatigue in the eyes.

b. Combinations of lines.

We may now pass from the beauty of the single line to the satisfaction we take in the arrangement of two or more lines, — in harmony and proportion. The chief result of the experimental investigations in this region has been to reveal the presence of peculiar mathematical relations in those combinations which are most agreeable. Figures like the square or circle, which show equality of dimensions, give us a mild satisfaction because of their very regularity. They are special and extreme cases of that symmetry to which, in spite of occasional coolness, we all have a deep-seated attachment. Our fondness for symmetry, except when it is overdone and rouses us to rebellion, is probably not unlike our satisfaction in graceful lines: we like its orderliness, its intelligibility, while at the same time it offers always a variation of its theme, in that the one half repeats and yet reverses the arrangement of the other. Its very likeness in this respect to the regularity and variation in the single line has tempted men, more and more, to explain its attractiveness in a similar way, as due to the character of the eye-movements which it evokes, although in the case of symmetry such theories lay less stress on the mere ease, and more on the balance of movements, or on the repose of the eye which symmetrical arrangements induce.

Symmetry.

Eye-movement theory recurs,

and is again unconvincing.

But the reasons already given seem to make such a theory quite unconvincing. And, moreover, direct experiments indicate that symmetrical figures do not, to any appreciable extent, invite the eye to rest, or to balance of movement. Figure 50 is a copy of a photographic record taken in the way described on page 238. An outline like that in Fig. 51 was placed before an observer, with instructions to look at the figure in a natural way, nothing of course being said in this case about following the line. No "balance" of eye-movements is evident. The eye roves quite irregularly over such a figure, and yet, in spite of the waywardness of these organic motions, the absolute regularity of the external form itself is fully felt. The eye-movement theory here again finds no support in the facts. The satisfaction, as in the case of single lines, does not lie in the muscular sensations aroused, but in our appreciation of the character of the form itself. It is a pleasure of form, and not of sense merely.

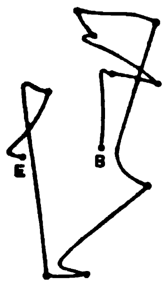


FIG. 50.—Record of the eye's course in looking at Fig. 51 freely with no attempt to follow the outline. *B* is the beginning, *E* the end of the record.

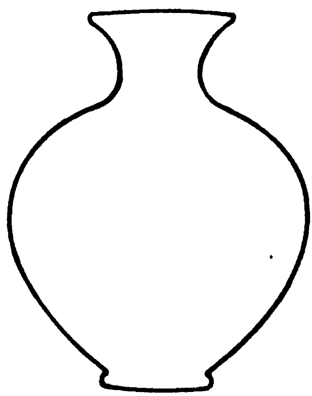


FIG. 51.

But passing from symmetry with its equality of parts, distinct mathematical proportions are found imbedded in other experiences which give us æsthetic pleasure. The musical tones, for instance, which make a harmonious union are those which stand to each other in a very simple arithmetical ratio. In the harmony of the octave, the upper tone has twice the number of vibrations of the lower; in the harmonious interval of the fifth (*c–g*), the ratio of vibrations of the two tones is as 2:3; in the fourth (*c–f*) the relation is that of 3:4; in the third (*c–e*), 4:5, and so on; while the more complicated ratios, as that of 12:13, affect us as discords.

Pleasure and mathematical ratios.

Musical harmony.

No such law has been found in the case of pairs of colors which harmonize. Colors have their rates of vibration; but some colors whose rates would make as simple a mathematical ratio as appears in musical harmonies, are distinctly antagonistic, while other combinations whose ratios of vibration would correspond to a musical discord give a pleasing effect.[1]

Color harmony.

But in space-forms, a study of the combinations of lines which seem to be in due proportion shows that here, also, there is an approach to a simple arithmetical relation. The most remarkable instance of this kind is found in our preference for particular proportions in rectangles. An æsthetic tendency of this kind, having a fairly constant character, is shown in the general shape of book-pages, panels, pictures, and the like. Fechner and others have found that on the average the preferences of people fall near

Proportion of lines.

The "golden" ratio.

[1] Cf. Helmholtz, *Physiologische Optik*, 2d ed., pp. 399 *et seq.*

that rectangle whose shorter side is to the longer as this longer is to the sum of the two — a figure that can be constructed by making the two sides in the proportion of 1 to 1.618, or roughly, of 5 to 8 (Fig. 52), a ratio now generally known as the "golden section." Experiments, moreover, on a wide variety of space-arrangements where the feeling of proportion enters, — in merely dividing a perpendicular line, for instance, so that the two parts shall seem in harmony; or in selecting from ellipses whose axes are of different relative lengths the one most pleasing, — in all such cases there is found to be an astonishing partiality, not invariably for the golden section, it is true, but for a ratio somewhere in its neighborhood. The Roman cross shows the force of this feeling of proportion; the cross-bar here has, for æsthetic reasons, been lowered decidedly from its position in the actual instrument of execution. In general, if there is free choice, we prefer not to have actual equality of the main dimensions, such as appears in the square or circle or the Greek cross.

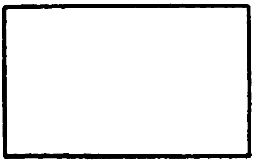


FIG. 52. — Rectangle whose sides have the proportion known as the "golden section" (1 : 1.618 +).

Alleged delight in mathematics.

Those with strong mathematical proclivities have tried to explain these results as due to some secret enjoyment coming from the mathematical instinct. The attractiveness of a figure which shows the golden proportion, according to this view, consists not in its immediate space-appearance, but rather in the peculiar arithmetical formula which the figure

embodies. A similar theory would explain our satisfaction in musical harmony as likewise a gratification of our mathematical sense; we, so to speak, subconsciously count the vibrations and notice that they stand in a simple and pleasant numerical relation.

Fickleness of this mathematical taste

But if we accept this hypothesis, it would be difficult to see why a certain mathematical idea should be so gratifying when embodied in visual material, and yet not be especially attractive when given in the form of sound. Thus the golden ratio, that pleases us in the rectangle, is by no means the most satisfactory when incorporated in musical tones. Two tones, one of 128 vibrations and the other of 207 vibrations, (the golden ratio), strike us as at least a somewhat strained harmony. And even if we were to suppose that in the perception of tones we were subconsciously aware of their vibrations, would it not be quite as difficult to account for our decided preference for a ratio such as that of 4 to 5, which is a musical harmony, as against the ratio of 10 to 11, which is musically discordant? As a bare mathematical ratio, 10 to 11 is as good as any, and yet when embodied visually or in auditory material it would not be received by many of us with marked favor. And if further evidence were needed that the mere incorporation of certain arithmetical ratios is not of itself attractive, it could be found by experimenting on divisions of time according to the proportions which please in other fields. If we mark off two stretches of time so as to make the proportion of 5 to 8, which pleases us in the rectangle, or the proportion of 4 to 5, which satisfies us in pitch, we find

that these temporal realizations of the mathematical idea leave us æsthetically unmoved.

The mysticism of number.

From these instances I think we may be justified in the generalization that the soul is not particularly responsive to simple mathematical ratios as such. The theory itself is a curious bit of mysticism — a remnant of the old Pythagorean philosophy of number. But certainly it is impossible to believe that the numbers *per se* are pleasant when they are agreeable to us as exemplified in space, but not when presented in time, or when one set of numbers pleases us in sound and an entirely different set in color.

It is easier to find what is not the explanation of our choice of combinations of tones or colors or lines than to discover what the cause actually is.

The variety of causes here.

It is probable that in these different cases different factors are at work. As for musical harmony, and for color harmony in so far as we have in mind simply the agreeableness of complementary hues like purplish red and green, for instance, or blue and yellow, their explanation apparently lies mainly in our physiological constitution. The concordant notes or colors produce no nervous rasping or friction; the one restores the organ which has been wearied by the other; they give us, as Mr. Grant Allen expressed it, a maximum of stimulation with a minimum of fatigue. But when we turn to those beautiful combinations of colors that are near akin — the similar but slightly contrasting tints of yellow in the daffodil, or those varied harmonies of brown in the late summer landscape of California — I doubt if the nervous resources of the eye itself are much less

taxed in viewing these than if there were an absolute monotony of tone. The refreshment which the slight departure from the dominant note here affords is not so much a refreshment to the physical as to the mental eye. The comparison of the hues and the appreciation of their similarity, as well as of their contrast, gives us pleasure; the recognition of their veiled differences adds to the pleasure we receive in the terms themselves. Something of this kind probably is also present in those figures which preserve the golden ratio: the golden section is a golden mean between monotony and violent contrast. A happy balance is somehow struck between too little variety and too much. But why the balance should be struck at the particular point which the experiments show, no one is yet in a position to say.

Our enjoyment is from many sources.

The chief result of these various experimental studies is, consequently, to bring out the truth that our enjoyment even of the rudiments of beauty comes from many sources, and that it is impossible to adopt a single principle which will apply to every case. It is impossible to say that all our æsthetic pleasures can be reduced to sensuous enjoyment. Some of the pleasure certainly is an enjoyment of the sensations themselves; the note of the linnet, or the pure blue of the sky, is good as mere sensation; but over and above this there is a pleasure in the arrangement or form of the sensations, and in the sympathies and reactions which such forms call forth either directly or by force of association. And yet we must not so emphasize our enjoyment of form as altogether

to deny the existence of a pleasure of sense. Again, the principle of unity in variety, to which writers on æsthetics are ever recurring, is undoubtedly important, as we found in the case of symmetry and of all those proportions which strike us pleasantly; but alone and of itself it will explain nothing. Unity in variety *per se* is absolutely indifferent and unæsthetic; a government letter-box has a kind of unity in variety quite as truly as a Greek vase; and a railway time-table, as truly as "Lycidas"; but the mere embodiment of these abstractions does not make them artistic. In any real work of art we demand that there shall be unity in variety, but we ask for much besides. So that the psychological study of the very elements of art shows that none of these principles can stand alone. At the very bottom, even in what we regard as purely sensuous enjoyment, certain higher factors are bound to enter; we like our colors or our sounds to be complicated and not too transparent; we like them to surprise us; we like them to have pleasing associations, or to be imitative of colors and sounds which we know and can recognize. Thus, the tone of the violin gains much by its likeness to the human voice; while the faultless note of the tuning-fork seems unnatural; it is too crystalline and unvocal. And, on the other hand, even in the highest products of art, the purely sensuous element is still present. Understanding and sense, form and matter, are in inseparable company throughout the entire course.

Higher and lower are intermingled throughout.

CHAPTER XIII

COLOR AND THE DIFFERENTIATION OF THE FINE ARTS

Sense *vs.* understanding.

THE sensuous element and the element of form or arrangement, although inseparable, do not affect all persons with equal force. There has always been more or less partisanship in regard to the two; so that theorists as well as artists have taken sides and have emphasized, now the bare sense-impressions, and now those aspects of things which appeal more strongly to other sides of our minds. Just as in questions of philosophical doctrine there have been from ancient times the friends of sense, or of matter, like Democritus; and, on the other hand, there have been those like Plato and St. Paul, who felt that the true life was mainly apart from sense; — so in art, too, the enmity between flesh and spirit has been evident, and although perhaps not so vehemently argued as in former times, it is still present in the practice of to-day. Artistic reactions occur, now in favor of form and meaning, while again the desire is to do justice first and foremost to the pleasure of eye and ear. Impressionism, for example, is such a reaction, is an attempt to give its full due to the brilliant colors of things, regardless of whether we are able to discern what the things themselves are or not, and often

becoming in its extremists a half-mad revel in the immediate impression, bereft of form and intellectual order.

The opposition of color and line.

Now, so far as the opposition is simply between drawing and color, our psychology is able to point to several facts that undoubtedly have a bearing on the question. There is good evidence that the sense of color is of later psychological development than the sense of form. Long before there is any vision, we have a muscular and tactual apparatus for perceiving space-arrangements. And even to the end, our color perception is so unstable and easily lost that we can well believe that the feeling for form is more deeply implanted in our constitution than is the sense of color. It may not be true that all children are color-blind during the earliest months of infancy, as some believe; but all our lives there is a considerable portion of the field of view where we are either totally color-blind or are, at most, sensitive to color only of extreme intensity. If small colored disks be brought into the margin of vision so that we do not look directly at them, there will be found a wide zone in which we can see the shape of the object distinctly enough but not its color; the color does not appear until the object is brought nearer the centre of sight. The whole of vision, consequently, is a vision of form, while only a part of it makes us aware of color.[1] The number of persons who are color-blind even in

The interest in space-forms is the more primitive.

[1] That the analogy between color-blindness and vision with the border of the retina must not be pushed too far is shown by various recent investigations; see, *e.g.* Hellpach, *Philosophische Studien*, Vol. XV, p. 524, and Arnoult, *Revue Philosophique*, Vol. XLIV, p. 110.

the very centre of vision and yet retain the power to grasp visually the shape of things, shows how relatively ill-established our color vision is, in that it can so readily slip away, leaving us, as some have supposed, in our ancestral state of colorless sight.

Personal equation in regard to color and form.

Now, whether or not there actually be a widespread difference in the purely physical endowment of men whereby some are sensitive to color in a much higher degree than others whom we have no reason to regard as color-blind, there certainly is a widespread difference with regard to the interest in the color of things, as compared with their form. It may, or may not, rest on an actual difference in our eyes themselves. Even apart from any such difference, the interest in form is of necessity more deep-seated than that of color; it is less a luxury and more a factor that is indispensable if one is to deal with his environment and live. The characteristic marks of things by which we recognize them and treat them as friend or foe are given in their form; the color is relatively unimportant. How much more the colorless photograph tells — of scenery and of portraiture, for instance — than any possible color chart, which should never so faithfully set forth in columns the tints in a particular landscape or in a person's face, but tell nothing of the form and arrangement of these colors. For this reason, we must attend to the shapes of things or die, whereas an interest in color is rarely, if ever, forced upon us; it is not one of the fundamentals.

Of this pair, color is more a luxury.

Now in this regard, while most persons keep well within the lines of common utility — in that the form

Exaggerated development in each of these two directions.

of things interests them, but not unduly, — there are others whose interest takes a turn that is as yet apparently useless and inexplicable. We have one group made up of persons for whom color has in some way come to have an exaggerated importance, while there are others in whose mental life spatial form plays an abnormally prominent rôle. Such a division seems to be borne out by certain phenomena, noticed in recent years, which show in many individuals a curious tenacity for pure spatial relations, so that all things, even when not spatial, are persistently represented as having this form; while others think of things preferably in terms of color, although

Colored sounds.

the objects themselves may be colorless. Some persons represent all sounds as having color; an acquaintance of mine thinks of the higher tones of the musical scale as yellow, while the lower tones have a purplish cast. Such persons may hear all words as colored, and even the separate elements of words have their separate tinge. In the word "size," for example, one of my students hears the opening *si* as yellow passing into orange, while the closing *z* sound is distinctly red. Here color has evidently come to the mental foreground and would monopolize the

Space-thinking.

attention. In the other type of mind everything runs to spatial form. All ideas here have their spatial symbols: — in a case I know of, Wednesday is always represented by a window with draped curtains, while Monday is thought of as a triangle with a dot in the centre. A large number of persons always picture the common series — the months, the alphabet, the number series — as arranged in

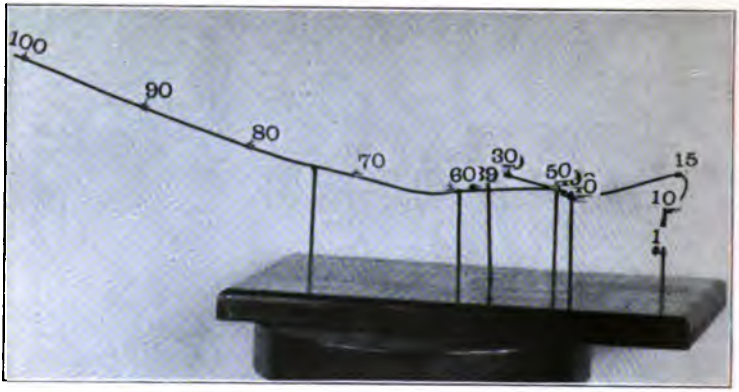


FIG. 53. — Wire model of a mental number-form.

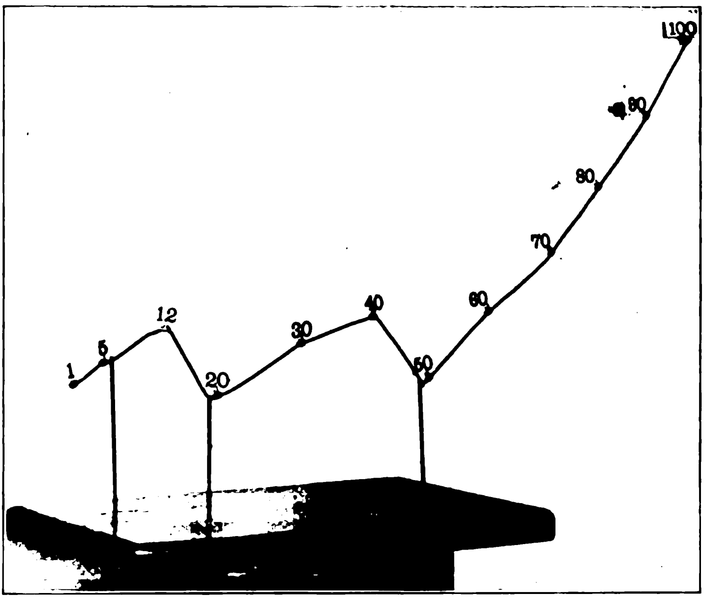


FIG. 54. — Wire model of a mental number-form. In this and the preceding figure, the vertical supports are not a part of the subjective form.

some very definite shape, often exceedingly intricate and with no apparent logical appropriateness, but yet quite constant for them as far back as their memory reaches. The accompanying number-forms (Fig. 53 and 54) are those of two of my friends who belong to this type. The second of these forms belongs to one who is especially interested in architecture, which would be additional evidence of the rôle that spatial, colorless form plays in his mental world. A peculiarity of this same number-form (to which writers, so far as I know, have made no reference) is that with the higher numbers the person changes his point of view, apparently turning the form, as a whole, around, and looking at it from an opposite side.

The divergence of color and drawing in art.

But while it might be questioned whether later investigation will show that there is the significance here conjectured in these curious tricks of mind, there are certainly the two classes of men: the larger group who keep to the great underlying interest in form — the interest to which nature herself early trains us; the other and smaller group who have developed in a most unpractical way a peculiar interest in color. This difference makes us understand better the different excellences of artists, as well as the different sympathies which the laity feel with contrasting schools of pictorial art. According as the chief pleasure is taken in one or the other side, do men demand that the drawing or the coloring of a picture shall not be deficient. And for a like reason, there are artists whose strength lies in color, like Rubens or the Venetians, while others

frankly turn to sculpture or line-work, or when they use pigments they find their chief joy in producing effects in which color plays a less essential part, and contrast of shadows and light, or the modelling of figures, is the main interest, as in the work of Rembrandt or the frescos of Michelangelo.

Rivalry of the sensuous and the interconnective element.

But if the opposition between color and pure space-arrangement as shown in such instances as these were the whole story, there would be perhaps some little ground for the feeling already referred to that the sensuous and the relational, or "formal," side of art are in conflict. But the great historic doctrine of an opposition and even an antagonism between sense and understanding has a firmer foundation than this. For it is found that the economy of the mind is such that if the sensuous element comes into prominence, it does so at a certain cost. Great vividness of sense-impressions hinders the suggestiveness, the meaning, of the impressions; and, on the other hand, our grasp of the interconnection of things — the play of understanding over and around an object — takes the life from the sensations which the object gives. So that nature herself forces a choice upon us, and will not give unstintingly of both at once. Thus if we would see in any object its pure color in all its native force, we must in some way obscure the *meaning* of the color, either by slightly turning the head or by looking at a broken or inverted image of the thing. Notice, at dinner, what fresh pink color your friends' faces show when reflected in the curved surfaces of the silver; or from your study-window see how much

Nature forces us to subordinate one or the other of these.

more violet are the shadows under the trees when you draw your curtains and see the landscape, not as foliage and earth and shade, but as meaningless splashes of color through the white curtains themselves. And, further, we can never appreciate so well the subtler relations of things if the objects themselves impress our senses too strongly. If we are close to a speaker addressing a large audience, the mere force of the sound hinders our thought; the auditory experience is so prominent that the full association, the significance, of his words, less freely arises. And the same is true if we are too near an orchestra; the connection, the unity of the effect, is lost in the individual sounds; we cannot see the forest for the trees.

Poetry, in deepening, makes less appeal to the ear.

It is because of this general law, it seems to me, that all poetry as it becomes more serious, suppresses, in some degree, the sensuous auditory element. Rhyme or recurrent alliteration are felt to obtrude themselves and hinder the higher functions of mind, as do also too obvious metrical effects. Children's verses can stand all this; it is suited to the lyric temper. But in general the more thoughtful, — the more spiritual, — the mood, the less it can tolerate of mere sensation. It is true there are troublesome exceptions, like the *terza rima* of Dante. But it is perhaps more characteristic that Shakespeare neglected his rhymed couplets as he grew older; while in the poetry of Job and of the Psalms the more prominent feature is neither rhyme nor measure, but rather a stately form, imperceptible to the senses — an antithesis or repetition, with solemn emphasis, of

the thought itself. If there is any other metrical arrangement, it is so obscure that its very existence is still in dispute.

Separation of arts so that each element may get its due.

But this does not mean that a purified art will of necessity become supersensuous; there is no indication that art as a whole is to grow more austere. So far as we can now see, the tendency is rather toward a division of labor — toward the development of special arts in which the different ways of appreciating beauty shall each be recognized without slight: some arts in which the sensibly present impressions shall be all but eliminated and the enjoyment connected with the ideas they arouse shall be the chief thing; and other arts in which the mental activity of interrelating the parts of the composition is subordinate and the sensory pleasure of the moment can come well to the front. Music and poetry are good instances of such a development already completed.

Instance of the auditory arts of music and poetry.

In primitive life, music is not cultivated as of value in itself; it is subordinate to the dance, or it appears as undistinguished from poetry — the verses are chanted or sung. Music is here but a handmaid of other arts. But men finally perceive that it is impossible to do full justice to all sides at once, and that if the ideas of poetry are so excellent as to engross the attention, the mind will inevitably neglect the sensuous clothing of the thought, — the music of the verse; and, on the other hand, the mere musical side can satisfy us better if attention is not demanded for other things. Think of using *Hamlet* as the libretto of an opera! The opera is always a compromise; it gives us neither the highest musical nor the highest dramatic

effect.[1] For this reason music finally asserts its independence of dancing and poetry, and is cultivated for its own sake. The modern development of pure instrumental music thus does justice to the sensuous side, which poetry has more and more neglected. And in such music even an imitation of natural sounds or any intellectual constraint is of doubtful propriety. Because of this the descriptive pieces of Berlioz do violence to one's sense of fitness, and we resent it when some one proposes to interpret Beethoven's Fifth Symphony as a philosophical tract.

The visual arts are perhaps undergoing a like development.

No such complete differentiation has taken place in the visual arts, and it is perhaps doubtful whether it ever will occur. And yet there are signs of such a movement. We are certainly much more willing to separate sculpture from painting and are more satisfied with the colorless form of things than were even the Greeks. They often colored their marble buildings and statuary,—a treatment which we should now regard as in bad taste. And our strong interest in work in black and white is further evidence that we can enjoy visual representations from which color is entirely excluded. The natural correla-

[1] I must, of course, leave the settlement of Wagner's place in art to others. His "music dramas," especially those of the *Ring* Cycle, do not seem to me a refutation of the view here espoused. The music in them is unsurpassed as decoration or atmosphere for the great dramatic movement; but, judged by itself and apart from this ancillary function, it hardly appears to reach the excellence of the best independent music. And while his librettos are probably the best of their kind, yet even the partisans of Wagner would hardly wish them to be compared, as dramas, with the works of Sophocles or of Shakespeare.

tive of this would be an art in which color should come to the very front — an independent art in which hues should play the same rôle that tones do in music. The nearest approach to this is where the colored surface has ceased to be immediately imitative, as in certain conventional patterns of mosaic or fresco or weaving. But here the art is one of color and spatial design together, and not of color alone. And ordinary painting permits even less freedom in the use of color. The most radical colorist of the day would never quite dare to lay his pigment on so that it gave no suggestion of natural objects; painting is bound more or less by the laws of imitation both as to form and as to color. If an artist's color seems extreme and wide of the facts, he will usually attempt the defence that at least he himself actually does see such tints in the object. But the musician is entirely free from any such restraints; he is never asked to show that natural things give forth the tones and harmonies that he presents, and that he is merely revealing them to us. Even in the well-known passage in Beethoven where Fate, it is said, is knocking at the door, how free the artist is to present this in tones that it would be impossible to think of as due to strokes on wood! It is given chiefly by the strings, and the abstract rhythm and force is in fact the only point of resemblance to the object the artist may have had in mind.

Non-imitative color has as great emotional value as musical sound.

The reason why no similarly free use of color has been developed does not seem to me to lie in the character of color itself. Its splendor and emotional power

is certainly not less than that of sound. And if given in proper sequences, with regular variations of intensity or tone, it is capable of giving us the feeling of rhythm that music offers. Sound, then, has no inherent advantage over color; its earlier attainment of an independent position in art is probably due to the greater mechanical ease with which it can be produced and rapidly modified. If it were mechanically simpler, nature would have supplied us not with a voice, but with some kind of an organ for the emission of colored lights in rapid succession. Think of the handicap such an organ would have given in the struggle for existence! how it could have been used as a kind of search-light for prey, or in communicating with distant friends, or to excite admiration and love in primitive courtship! Or if it had been possible for man to change the color and intensity of fire and make it answer his bidding at the instant, with the same ease with which he can strike the strings of a harp or change the pitch and volume of sound from his simple pipes, the free artistic use of light would have been as inevitable as music. It is fast becoming possible for men to have this perfect control over brilliant colors, and it seems to me probable that in the distant future, when the unbeautiful associations of carbons and dynamos and insulated wires shall have passed away, and all these things shall be thought of as having existed from an immemorial past, pure color in harmonious combinations, passing in stately and rhythmic cadence through the gamut of brightness and of hue, and the whole worked out with be-

Its artistic possibilities

ginning and climax and close — all this may not seem unfit to be used as a means of æsthetic expression.[1] That a display of color itself, apart from any inherent imitative meaning in its arrangement, is capable of producing noble effects is shown by the feeling with which men have always watched the spectacle of the sunset.

Conclusion. But art is long, and if one were to keep merely to the psychology of it, he would be led on and on. The enjoyment we take in imitation has had but a passing sentence; the pleasure we find in expressing ourselves; the absolute need there is of giving expression to our nature; the reasons why art and play are so refreshing, — all these have not had a word. We have only noted some few things that lay within and near the borders of the experimental work. As I said at the beginning of the preceding chapter, the experiments confessedly deal with but the rudiments of the artistic impulse. There is perhaps no need of an apology because they do not usher in the whole philosophic truth. They have brought us a little nearer to a complete natural history of art. It is easier through them to see the varied features of beauty, and to mark how its many minute details con-

[1] An elaborate system of this kind has recently been proposed by Favre, *La musique de couleurs*, Paris, 1900. He points out how different a true art of abstract color would be from the mere "play" of our electric fountains. According to the account in the *Revue Philosophique*, January, 1901, he proposes "scales" and "keys" of color. I cannot find, however, that he has thought of the great possibilities involved in the careful application of rhythm. The opportunities for its use in a color succession are even greater than in the case of successive sounds.

tribute to the total effect. If they assist us also to understand something of the reasons for personal preference and for the historical growth and separation of the arts, they may be accounted at least the beginning of an excellent work.

CHAPTER XIV

THE CONNECTION OF MIND AND BODY

The distinction of mind and body.

THE distinction between mind and body, spirit and matter, is a comparatively late achievement. In the youth of the world, men were neither materialists nor spiritualists. For them, physical processes were infused with spirit, while spirit itself was a kind of material thing. So that consciousness could be regarded as on the same plane with purely physical processes, like digestion or breathing. Homer, for instance, does not hesitate to say that Hephæstus, the clever mechanic-god, made golden handmaids that not only moved about, but had "intelligence in their hearts" and "skill of the immortal gods."[1] Thinking was evidently here conceived as something that a well-contrived machine could do. With a deeper hold on life, however, men begin to distinguish between the things of the flesh and those of the spirit; mind and body stand out in strong contrast, and it then becomes a question what the connection of the two may be.

Problem of their union.

Like every study that comes close to the moral and religious interests of men, this has had its prejudices

[1] *Iliad*, Bk. XVIII, ll. 417 *et seqq.*, especially: —

> Τῇς ἐν μὲν νόος ἐστὶ μετὰ φρεσίν, ἐν δὲ καὶ αὐδὴ
> Καὶ σθένος, ἀθανάτων δέ θεῶν ἀπο ἔργα ἴσασιν.

to overcome. One party has been so sure of the things of the body and of natural law, that the thought of activities immaterial savored to them of superstition and nescience. On the other hand, those who felt so keenly the reality and supreme demands of the spiritual life could not tolerate the thought of its essential connection with the body; between corruption and the incorruptible there could be no bond.

Trend of physiological psychology.

The result of the present-day physiological psychology favor neither side; or perhaps we may more truly say it favors and opposes both. So the trend of the present chapter will be to propose a *via media*, with all the advantages and disappointments which compromise and halfway statements always bring.

I. The physical expression of mental states.

In two different directions there have been important additions to our knowledge of the connection of mind and body. It had always been apparent that the mind influenced the body: that we could will to move our hand or foot, and the body obeyed our inner command; that different emotions had their characteristic bodily effects, — the clenched fist, the contracted brow, the set jaw of anger, the smile of pleasure, and so on. And in the chapter on "Imitation and Suggestion" it was shown that, even without any perceptible emotion or act of will, the mere idea or suggestion of an action when once it lodges in the mind tends to flow out through our nerves and muscles into the very act itself. We cannot see another's movement without in some degree, as it were hypnotically, imitating his act.

But it remained for modern psychology to show

The subtlety of these organic responses.

that in even subtler ways than these the mental state is reflected in the condition of the body. It is now known that imperceptible changes of the inner organs follow every shade of variation of the psychic life. The most important of these physiological alterations are found by examining the distribution and pressure of the blood under different psychological conditions — an examination which has been made possible by some clever recording devices, delicate, yet in mechanism simple enough. The apparatus for recording the pulse is called the sphygmograph, one form of which is shown in Fig. 55. But by a still better contrivance called the plethysmograph or (save the mark!) sphygmoplethysmograph (Fig. 56) we get not only the pulse, but the changes in the general volume of a limb. The principle here applied is as old as Archimedes — that if anything is immersed in water, the level of the water will rise according to the volume of the object we put into it. If we enclose the forearm, for instance, within a glass cylinder, and, through a small opening at the top, like the neck of a bottle, pour in tepid water until the cylinder is full, the height of the water in this opening is found to vary from time to time, according to the mental state of the person whose arm is in the vessel; and, by means of a simple pneumatic contrivance, these changes of the water's level can be made to write their own record on a sheet of moving paper.

Apparatus used.

Character of the records.

In this way we get a somewhat complicated line, every rise of which denotes that the arm at that moment expanded, while a fall implies that its volume diminished. In the accompanying record (Fig. 57) the

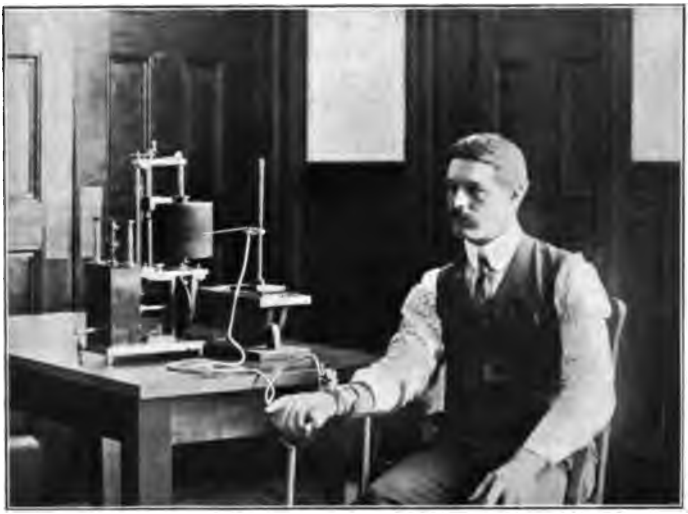


FIG. 55. — Sphygmograph.

FIG. 56. — Plethysmograph. For recording changes in the volume of the arm, that accompany changes in the mental state.

smaller wave-like changes are due to the separate pulsations of the heart which force the blood rhythmically into the extremities; and since the blood-vessels are elastic, greater pressure makes them expand, and with less pressure they contract. The volume of the arm thus changes at every heart-beat. The upper curve of this record shows the normal pulse of the forearm during mental repose. But, near the beginning of the second line of the record, at the point marked by the arrow, the person who was here experimented upon was asked to multiply 22 by 14, and it is clearly seen that immediately thereafter the form

FIG. 57.—The upper record is of the normal pulse in the forearm. The lower shows effect of mental arithmetic (multiplying 22 × 14). (From Mosso.)

of the individual waves changes so that there is no break in the up-stroke, as there was before. But, more important still, the general level of the curve is different, showing that the volume of the arm for a short time increased, and then was steadily reduced. Far more striking results can be obtained if we record, not the change of volume of some outlying member, like the arm, but the alterations of the brain

Mosso's experiments on the living brain.

itself. Mosso, the famous Italian physiologist, experimenting on several unfortunates whose brains had been laid bare by accident or by necessary surgical operation, was able to take tracings of the changes of volume of the brain under different mental conditions.[1] He found that an increase of mental action is signalized by a sudden increase in the size of the brain, due, no doubt, to the added amount of blood which is immediately forced up to it. The accompanying records (Figs. 58, 59, and 60) were taken during experiments on an Italian peasant, with an arrangement of apparatus in principle like that already shown in Fig. 56.

In the first of these (Fig. 58) we have a simultaneous record from brain and forearm, the upper curve of this figure being that of the brain. At the point marked by the arrow, the man was required mentally

FIG. 58.—Simultaneous record of pulse in brain (upper curve) and forearm (lower curve). At *a* the subject is required to multiply 8 × 12; at *ω* he gives the answer. (From Mosso.)

to multiply 8 by 12, and at *ω* he gave the answer. It is noticeable how much more marked is the change in the brain, at these critical points, than in the forearm.

[1] *Ueber den Kreislauf des Blutes im menschlichen Gehirn*, Leipzig, 1881. Figs. 57–60 are taken, by kind permission, from this work.

The next record (Fig. 59) was taken while this peasant, Bertino, was asleep, and shows the effect upon his brain produced by calling his name aloud, at the point marked by the arrow, yet without

FIG. 59. — Record of brain pulse during sleep. At the point marked by the arrow, the subject's name is called, without, however, awakening him. (From Mosso.)

awakening him. Not only does the volume of the brain change, as shown by the general rise of the curve, but the individual waves have a different form, having elevations on both sides of the crest, whereas before this stimulation the extreme left-hand elevation of each was the highest.

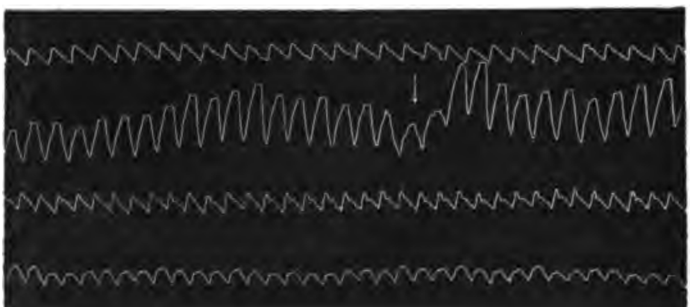


FIG. 60. — Simultaneous record from brain (1st and 3d curves from bottom) and forearm (2d and 4th). The lower two curves are during repose; the upper two during strong emotion. (From Mosso.)

The record in Fig. 60 was taken during an experiment that was in progress at midday. The curve

at the very bottom shows the pulsations of the brain while the man was at perfect ease, the curve just above it being the simultaneous record from the forearm. Later on, he was upbraided for some slight movement which disturbed the experiment, and became excited and chagrined. The third and fourth curves from the bottom are a simultaneous record from brain and forearm, respectively, taken at this time; the waves of the brain-curve are wild and high, as compared with those taken earlier. Now, at the point in this third line marked by the arrow, the neighboring church-bell struck the hour of twelve; the curve suddenly leaps to a still greater height. Mosso found later that the peasant was accustomed to cross himself at noon, and say his *Ave Maria*, and his feeling of embarrassment at not being able to perform his simple rite is doubtless the reason why the stroke of the hour made such a sudden and marked change in a record already showing excitement enough.

The meaning of these experiments.

The result of all this, and of much more of the same kind,[1] is to bring about the conviction that body and mind are in most intimate connection, and that the intercourse of the two is not occasional, but is constant. Formerly we believed that some strong emotional excitement, or a definite act of will, must be present if there was to be any manifest expression of the mental state. But it is now generally accepted

[1] Considerable work has been done, for example, in noting the connection between pleasure-pain and the form of the vascular and respiratory tracings. The latest of such studies is that of Zoneff and Meumann, *Philosophische Studien*, Vol. XVIII, p. 1.

that the body reflects every shade of psychic operation; that in all manner of mental action there is some physical expression. "All consciousness is motor" is the brief statement of this important truth; every mental state somehow runs over into a corresponding bodily state.

Innocent as all this may seem, it has in reality revolutionized our view of *expression*, and of its influence upon mental states. We used to suppose that the bodily expression of what was going on in the mind was of no great importance as far as the mind was concerned; that in the case of fear, for instance, there would still be fear even if there were no palpitation of the heart, no pallor, nothing of what old Æneas felt when (as he says) — **They revolutionize our view of "expression."**

Obstipui, steteruntque comæ et vox faucibus hæsit.

But we now know better; we know that this outward physical expression, as we call it, is a most important thing; it makes the fear *real*. The feeling of what is occurring in our veins and muscles rolls back upon the mind and gives the mental state definiteness and "body." Without the physical concomitants and the feelings they arouse, the mental process would be pale and shadowy. Half the fun of a joke, therefore, is in the laughter; half the sadness of sorrow comes from an actual depression of body — a weight of physical distress.

It is not true, then, that there first exists a mental state in full vigor, which later operates upon the physical world. On the contrary, what goes on in our minds never is really there until it is expressed. **The mental state and its expression are one and inseparable.**

Externalizing an idea in some way, putting it off from us, so that it may return upon us as from without, is the only way to gain possession of it ourselves. We must try to articulate the thought, speak it to some one, put it into practical use, or it fails to take form. Modern physiological psychology thus points out that there is an *essential* connection between body and spirit, and is opposed to the older doctrine that the two are in antagonism, that the body and the sense-world are opposed to the moral life, — a doctrine that, developed in Plato, found expression in asceticism and the life of the hermit and the anchorite, — a life of pure contemplation, of mortification of the flesh, as opposed to physical activity and health. Such a doctrine is unpsychological. The body is not a clog upon the mind; it is not "a muddy vesture of decay" that hems us in. It is an indispensable factor in the highest development both of intellect and of character. A really disembodied spirit (the ghost believed in popularly is never quite disembodied, but always retains some tenuous shape), a spirit absolutely without a body, would, so far as we can now see, have no point of contact with a sensible world, no opportunity of giving sensible expression to its incipient mental processes. These processes would have no physical reverberation, and, lacking the quality by which alone they could become real to others, they would soon cease to be real to the person himself. This, I imagine, is the scientific basis for the old truth that "faith without works" is vain. A mental state that does not come to some characteristic

Character of a disembodied spirit.

outward expression is only a half-real mental state at best.

II. The seat of the mind in the body.

But we must pass to another field of investigation which has to do with the topic before us, — the investigation of the seat of consciousness. Brought up, as we are, in the belief that the brain is the chief organ of the mind, it seems as if each of us had some direct knowledge that thinking takes place in the head. But history shows that the unsophisticated man is ready to localize his mental processes almost anywhere but in his brain — in his heart (as Aristotle did) or elsewhere. One may recall the expression, "my reins instruct me in the night season."[1] But having found that the brain is, in some peculiar sense, the organ of the mind, the further problem arises, whether the mind has connection with all parts of the brain equally, or whether there is a still more definite seat of the soul. The older metaphysical definition of the soul — that it is a simple substance, and, because it is simple, necessarily without extension — led men at first to maintain that it could be present only at some single mathematical point in the brain. Now the brain is, in most of its structure, a double organ: there are the two halves of the cerebrum, separated by a deep fissure; there are two optic *thalami*, two *corpora striata*, and so on. But at one unique place, well covered under the mass of the hemispheres, and at a kind of geographical centre of things, there is a small body called the pineal gland, which has not the double structure so

The pineal gland.

[1] Psalm xvi. 7.

common in the other parts. Its smallness, — a very small pea is about its size, — its singleness, its central position, made it seem the fit habitat of the spaceless mind; and here Descartes supposed the soul had its seat, governing the body from this point of vantage, playing upon its stops, much as an organist at the keyboard controls his instrument. But later it seemed more suitable to think of the soul as in less gross surroundings; so its abiding place was changed to the fluid in certain cavities of the cerebrum known as the ventricles; here it would not be actually embedded in the nervous substance; it would govern the body through the brain, and yet without such immediate material contact. Thus did men, in their theory, guard the spirit from contamination.

The ventricles of the brain.

Phrenology and the cerebral convolutions.

Strange to say, it was Gall and the phrenologists who drew attention away from these curious speculations and emphasized the physiological importance of the *convolutions*, — the outer surface of the hemispheres, — teaching at the same time that different portions of the surface were given over to different spiritual functions: acquisitiveness, combativeness, reverence, and the like. This notion, that the nervous counterparts of the various mental functions are scattered about in the brain, was at first strenuously opposed, and much was made of such evidence as that afforded by the celebrated crow-bar case, where an enormous wound in the brain resulted in no permanent mental trouble whatever. And, indeed, there was no very good support for this doctrine of scattered localization until about the year 1863, when Broca made the interesting and important discovery

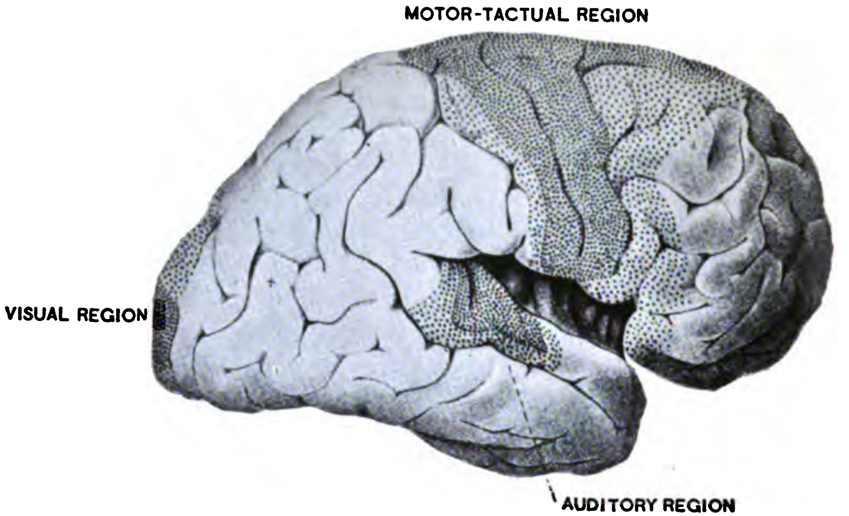


FIG. 61. — Diagram of the outer surface of the right hemisphere of the brain. The dotted areas represent the visual, auditory, and motor-tactual "centres," respectively. (After Flechsig.)

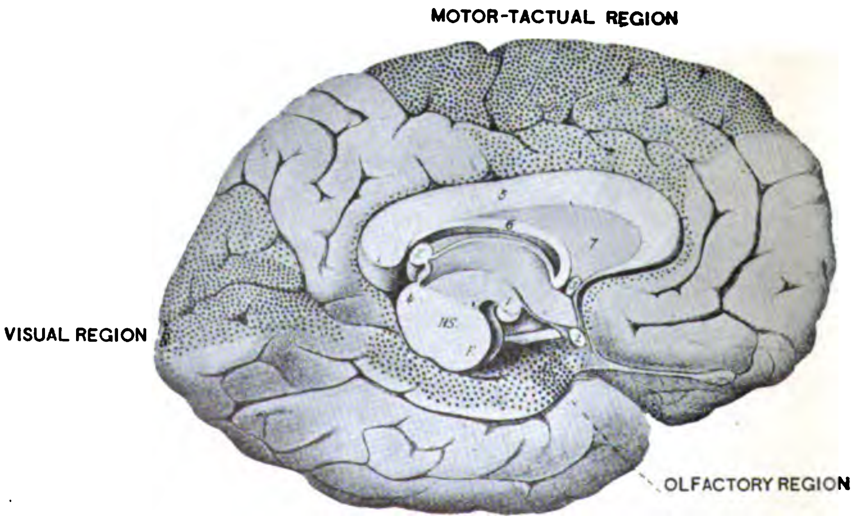


FIG. 62. — Diagram of mesial surface of the left hemisphere of the brain. The dotted areas represent, respectively, the visual, motor-tactual, and olfactory "centres." (After Flechsig.)

that if the third frontal convolution of the left side, in right-handed persons, was disordered (the region to which phrenologists ascribe "constructiveness"), speech became a hopeless tangle of sounds — a disease now known as *aphasia*. This was really the first of the great modern discoveries in brain-localization. The work was thereafter carried on, partly by experiment on living animals, by laying bare the brain and electrically stimulating it at different points, or by carefully removing portions of the nervous matter and noting any change in the animal's behavior. But the work has been marvellously aided by the use of chemical stains which have the power of bringing out the inner structure of the brain. This post-mortem staining and the careful examination of the effects of local brain-disease have been the main reliance in learning what parts of the human brain are of most importance for the mind.

Broca's discovery.

The later work on brain-localization.

The result of all this study has been to show that, in the first place, there is a wide zone, — beginning near the centre of the top of the head (the seat of "veneration," according to the phrenologists) and running downward and forward, — which has to do chiefly with the conscious control of the muscles. It is, for this reason, usually called the "motor" zone, although in all probability it is quite as much a region for the sense of touch and for all those feelings which come to us from our muscles and skin (Figs. 61 and 62). Even the brain-connections of special groups of muscles with this region are now pretty accurately known; so that the brain-surgeon, once he is certain that this surface of the brain is affected,

The motor zone.

can tell with considerable security what particular portion of it is diseased, according as there is, say, paralysis of the right leg, or of the left hand, or of the muscles involved in speech. Besides this motor region, or, as we might just as well call it, the zone of organic sensations,[1] special regions have been discovered for sight, hearing, and smell. The region for smell, as we might expect, is found to be located at the lower inner surfaces of the cerebrum that lie not far from the upper wall of the nasal cavity. The nervous centre for hearing lies on either side of the brain in what is called the region of Wernicke, — after its discoverer, — the place to which "secretiveness" had been attributed. And, finally, in defiance of all common-sense, the centre for sight lies in the very back of the head. Laura Bridgman's brain, for instance, showed a marked thinning out of the cortex of this rear region of the brain; it had not been used from early childhood, and had remained undeveloped.[2]

Sensory centres.

Cautions as to these results.

On the basis of these discoveries, one is tempted to say that the function of sight, for instance, is located in the posterior region of the brain. But this is only a careless half-truth. Probably all that we should be conscious of, if this region alone were active, would be the naked light impressions stripped of all association and, therefore, without connection and significance. For sight is much more than light

[1] Flechsig (following Munk), *Gehirn und Seele*, Leipzig, 1896, p. 62. Figs. 61–65 are taken, by kind permission, from this work.

[2] Donaldson, "The Extent of the Visual Area of the Cortex in Man, as deduced from the Study of Laura Bridgman's Brain," *American Journal of Psychology*, Vol. IV, p. 503.

and color; we must be able to make out what these signify; we must be able to translate them into tactual, auditory, or olfactory terms. We really see things with practically our whole brain, and not alone with what we call the visual centre. If a convolution of the brain cannot coöperate with other convolutions, it is as good as lost. Thus in a patient of whom we have a report by Heubner, disease partially disconnected the auditory region from the other parts of the brain-surface; under these circumstances the person, it is true, could repeat mechanically any words dictated to him, — he thus retained his sense of sound, — but he was absolutely unable to know what the sounds meant. For any very important function, then, the various parts of the brain act as a whole, and the phrenologists' notion is absurd that we imagine with one isolated portion of the brain, and recollect with another, and pass judgment with still a third. In the adult brain, at least, well-nigh all parts of the brain together take a hand in any significant action.

Peculiarities of the infant's brain.

Recent discoveries show that this is far less the case in the infant's brain. The development soon after birth shows that the different parts of the gray surface grow up in comparative separation. The very earliest to develop are the centres of touch and smell — the functions which the animal uses most; so that the babe is at first on this animal plane, where smell and touch are the chief avenues of the mind. The next to appear is the sense of sight; and last of all comes the sense of hearing.

Quite as interesting as this serial development of the different senses is the fact that these different

regions—of touch, smell, hearing, and sight—have at first no apparent nervous connections with one another. Not until almost the third month after birth are there the rudiments of fibres uniting these various sensory tracts.[1] This, of course, means that none of those conscious associations is as yet possible between one sense and another, which adults have when the sight, for instance, of heliotrope suggests its perfume, or when the sound of a person's voice recalls his face. It is difficult for us to conceive in what a disjointed condition the child's consciousness must be before this time,—sights that suggest no sounds, touches that arouse no thought of taste or smell, each item, as it appears in the mind, being blankly received for just what it is, pointing to nothing beyond itself, and, for this reason, being as nearly without form and void as anything in the mental life can be and still be mental.

The value of physiology for our study.

With this all too brief account of these discoveries I must leave the concrete, experimental part of the subject. But the importance of such facts as these for the natural history of the mind seems to me so evident that I cannot at all agree with a recent writer of high standing in psychology who has soberly urged that the physiologists cannot help us in the study of psychic phenomena—that physiology is constantly aided by psychology, but is of necessity unable to give anything in return. On the contrary, these studies of the nervous system offer a means of discovering purely psychological facts that we can unearth in no other way. How otherwise than by a physiological

[1] Flechsig, *op. cit.*, p. 106.

FIG. 63.—Section of infant's brain, one month after birth (stained). The relatively advanced development of the lower centres is shown by their taking a strong stain. (After Flechsig.)

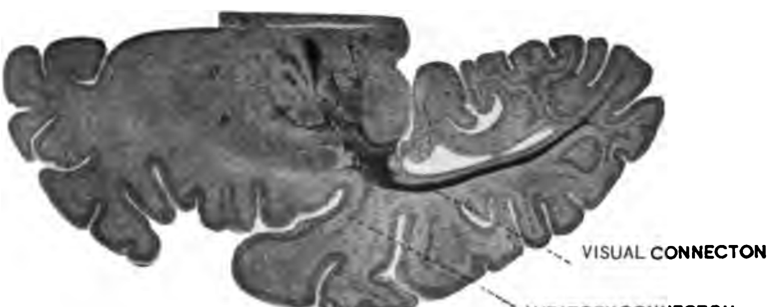


FIG. 64.—Stained section of infant's brain at beginning of second week after birth. The relative backwardness of hearing, as compared with sight, is shown by the faintness of the auditory connection as compared with the visual. (After Flechsig.)

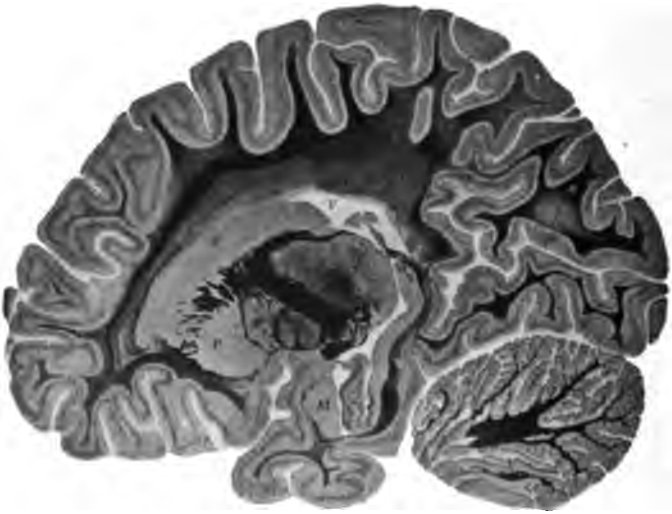


FIG. 65. — Stained section of infant's brain about five months after birth. Showing the advance in the development of the higher centres, as compared with Fig. 63. (After Flechsig.)

investigation could we yet have said, for instance, in what order the infant's consciousness of sense-impressions arrives or when the interconnections among them are built up? The value of the physiological work the psychologist must cordially acknowledge. And while it is true that the brain is not the mind, and that, in order to translate brain-discoveries into psychological discoveries, some knowledge of the purely mental realm is necessary, yet it would seem highly ungracious to withhold our appreciation for that reason and stiffly to insist on the exclusive worth of the introspective method. The value of the introspective method is sufficiently patent to free us from the need of proclaiming it both in season and out of season.

What is the true relation of brain and mind?

But on deeper grounds than these there is apt to be a clash between the students of mind and those of the brain. The physiologists often give the impression that, in their view, the brain-process is the only real process there is, and that mental phenomena are but a special way of regarding the action of the brain. Or if they do distinguish the nervous from the psychic act, the psychic is considered as a mere effect or expression of the activity of the brain. Now when we speak of cause and effect, we almost invariably imply that the cause is a much nobler and more significant thing than its effect. All of us, for instance, would prefer to be causes in the world rather than effects. So that when the brain-specialist announces that he has discovered in the gray cerebral matter the cause of mental operation, the lover of mind naturally resents this as a degradation of the object of his affec-

tion. If either is to be cause, he feels that this office should fall to the mind; the mind is the very kernel of personality, the seat of morals and intelligence, and must never be regarded as subject to the beck and call of matter.

The more prominent theories: interaction and parallelism.

We have, then, a number of doctrines in glaring opposition. In the first place, there is the view that the brain either is the mind or at least regulates the mind; and, over against this, is the conviction that the mind is superior to the brain and operates it. But this extreme opposition is usually softened so that now one side and now the other has the upper hand — the doctrine of interaction between mind and brain. Finally, there is another compromise theory that has a large and influential following at the present day, — a theory persisting from the times of Geulinx, Spinoza, and Leibnitz, that neither the brain controls the mind nor does the mind control the brain, but that they run in essential independence, side by side, like two clocks, both telling in their own way a consistent story, and yet neither of them exerting any influence upon its companion. This is the doctrine of parallelism. According to parallelism, there is no real interaction between mind and brain; the mind does not control the brain; neither does the brain, the mind; they are simply in harmony.[1]

[1] For brevity's sake I have taken what is historically the main current of parallelism. But the prestige of the word has led many to call themselves parallelists, whose views in regard to the relation of brain and mind are most divergent.

It seems to me that if the term "parallelism" is to have any

We cannot here review the strong evidences which each of these views presents. Only a single illustration in regard to parallelism can be presented. The facts of reflex action, — for instance, that a frog deprived of its cerebrum will croak, and swim, and perform other complicated actions under circumstances that preclude the thought that its mind is controlling its members, — such facts as these have led many to believe that all bodily acts are essentially of this reflex type. If the body is capable of doing so much without mental guidance, as reflex action shows, why not suppose that the body, of itself, without help from the mind, is capable of all? And if it can perform its many functions without mental aid, there seems even less difficulty in the other half of the theory that the mind performs its acts without aid from the body. According to parallelism, then, it is an illusion to believe that the mind controls the body. The body is an automaton, haunted by a mind, and the experiences of the mind correspond to the doings of its automaton body, and some of the doings of the body correspond to acts of its indwelling mind. But there is no real cause-and-effect relation between these two classes of acts. The bodily acts are caused solely by other physical acts; the mental events are caused solely by other mental events.

Reflex action favors parallelism.

definite meaning at all, it should imply, as it has, in the main, historically: —

(1) That every mental process has a fixed cerebral process regularly accompanying it temporally (and not just "logically"), and

(2) That there is no causal connection between the corresponding mental and cerebral processes.

But sense-perception is hard to reconcile with this view.

On first hearing a theory like this, one is apt to feel that there are plenty of known facts to disprove it. But such is not the case. Almost everything that we know about the mind and body could, perhaps, in an extremity, find a place within this view. At the same time there is a class of facts that require some torturing to make them submissive to the theory, particularly the facts of sensation and perception. Sense-perception is the crux of parallelism and will some day, I fear, be its death. The experience of seeing a bright light or of hearing a loud sound is quite as truly a mental occurrence as is a conception or a train of reasoning, and according to parallelistic principles must be explained by its mental antecedents without calling in any physical influence whatever. When you are startled from a revery by some crash in the street, caused, let us say, by a falling sign, your sudden mental impression (this theory has to assume) is not caused by the physical disturbance without, but by some mental processes essentially disconnected with the outer world. While physical nature has been rusting away the fastenings and stirring the wind that brings down the sign, the inner processes of your own mind, and of the minds of every one else in the neighborhood who hears the noise, have been silently preparing to call forth sound-sensations of similar loudness and jangle in the various persons, just in the nick of time when the sign falls and the air-waves cause the nervous disturbances that dart inward to the brain-cortex. When one remembers that not a shred of evidence exists of any antecedent mental processes

that might cause the sensations of noise (or of any other similarly unexpected irrupting impression), he begins to appreciate something of the enormity of this theory. It separates on purely *a priori* grounds phenomena that empirically have every evidence of causal connection. It thus leaves the world of experience in a disjointed condition that natural science will, as time goes on, be less and less inclined to tolerate.

Parallelism clashes with evolution.

But for still other reasons it seems probable that parallelism will in the end die of neglect. For the influence of evolution is directly against it. The machinery by which evolution moves is such that every important and wide-reaching fact in the world holds its place there only because it is of service. Every significant and persistent strain in human or in animal life can be accounted for only on the supposition that it is of use in maintaining the creature or its species upon the earth, and because of its use it has been encouraged by selection.

Now parallelism is in conflict with this biological principle of utility. For, if the mind only *seems* to influence the body, while in reality all physical acts spring solely from physical causes, then there is no accounting biologically for the presence and persistence of a reasonable and practical and social mind, such as accompanies the bodies of most men, as well as of some animals. It becomes at best a mere by-product or casual accompaniment of processes that are biologically significant. If parallelism were true, an entire absence of the mental stream, or the presence of a consciousness which took no interest in the welfare of the body, would have been no

handicap whatever. A mind that preferred cold and hunger and pain and unsocial ways would, physically speaking, be at no disadvantage if only its body preferred warmth and food and good society. Persons with well-adapted bodies, but with ill-adapted minds, could then flourish without let or hindrance. There would be no path by which natural selection could head off and destroy such monstrosities, and consequently their kind, which in the numberless chance variations would be sure to occur, would be as likely to survive as any other. As far as biology is concerned, parallelism is consequently, as Mr. F. H. Bradley has said, a doctrine of the uselessness of the soul.[1] And in the same way it is, psychologically speaking, a doctrine of the uselessness of the body. If all the efficient causes of experience are to be found in the mind alone, as parallelism maintains, then the body is a useless companion of the spirit, and has no essential place in its history.

The doctrine of parallelism, therefore, is bound to pass away, not only because we can point to definite facts, like sensation, that can be brought within it only by violence, but also because it is not in keeping with the principles of evolution and with the even broader principle that the various facts of experience cannot be kept insulated from one another. It runs counter to the general trend of our modern thought, and for this reason it is at a hopeless disadvantage in the struggle for acceptance.

[1] "On the Supposed Uselessness of the Soul," *Mind*, N. S., Vol. IV, p. 176; cf. also the fifth chapter of James's *Principles of Psychology*.

What, then, is the standing of the alternative notion, that mind and body really influence each other? What are the difficulties in such a view, and wherein is its strength?

The theory of interaction.

The main trouble is that mind and body seem to be so absolutely heterogeneous that it is difficult to see how one can act upon the other. It is much as if we were to attempt to boil water with the theory of probabilities. The terms which we try to unite stare vacantly at each other, and cannot be brought into any manner of intercourse. It seems reasonable that matter should influence matter, or mind, mind; but that consciousness, which is immaterial and unextended, should produce changes in the brain, which has entirely different attributes, — this has been felt by many to be at variance with the principles of modern science.

The two sides seem utterly heterogeneous.

It is at variance, in the first place, many think, with the ordinary conception of cause and effect. For if two things — an action of the brain and its corresponding mental process — are to stand in a causal relation, is it not necessary that they should be somehow comparable in quantity? Is it not always assumed that the effect has a certain quantitative relation to the cause, and that what the cause loses the effect gains? But how can we ever say how many units of physical energy are the equivalent of a mental desire or resolve? The two lie in different spheres, are incomparable, and consequently (it is held) the one cannot produce the other.

Causal connection seems to imply quantitative equality.

The force of this objection is somewhat broken by a number of reasons. In the first place there is nothing sacred and inviolable in the prevalent form

Weakness of this objection.

The idea of cause.

which the conception of cause has taken on. That there should be a quantitative equation between cause and effect is not one of those truths that are axiomatic; it has simply come about as a helpful device for dealing with phenomena in the physical world and of getting shorthand formulas (to use Mr. Karl Pearson's term) for expressing them. But what serves well when we confine our investigations to the physical world may not prove most useful when we try to cover the larger field that includes both physical and mental things. The successful description of this larger realm may require us to modify our notion of the causal connection, so that quantitative equivalence shall be less strongly insisted on. If, for instance, the definite evidence both that the mind is efficacious in the physical world and that nervous states influence the mind — if this evidence continues to accumulate at the rate that it has in the last decade, we may well be forced to give up our unnatural parallelistic way of describing the relation here, frankly admit a cross-causal connection between mind and body, and rearrange our notion of causality so as to fit the mass of empirical facts.

Quantitative correlation is not impossible.

In the second place, if quantitative equivalence is, however, to be regarded as indispensable to a causal connection, it is not impossible that this requirement may be met. A quantitative treatment of mental phenomena does not, to many, appear an utter absurdity. The preceding chapters, especially the one on "The Possibility of Mental Measurements," have given what seem to me the indications that it is not only theoretically possible to deal with certain aspects

of mind quantitatively, but that there has been considerable practical success in doing this. And while it may not be feasible to say beforehand how much nervous energy is the equivalent of any given mental fact, and only experiment can determine this, yet the same is true when we keep to the physical world. The mechanical equivalent of a given quantum of heat has to be found by experiment, and could never have been argued out *a priori*. The quantitative correlation is, in the first instance, "empirical," and a causal connection is felt to exist long before there is any assurance of these exacter mathematical relations. The chief evidence of a causal connection between heat and mechanical motion is the frequent occurrence of one with the other, and the variation of one as the other varies. Only later, and as an extra refinement, is it presumed that the energy in the two cases is at bottom identical and to be measured possibly by some identical unit. Now as to the cerebral and mental processes that would stand in a causal relation, the evidence is increasingly strong not only that they frequently occur together, but that they concomitantly vary in quantity. In the case of sensation and stimulation, to take by no means the only example, there is found a rough quantitative correspondence between the two terms, even though the more exact nature of that correspondence be variously judged according to the special way in which we interpret Weber's Law.

Difficulty even in the physical realm.

And as a final (though, perhaps, a less cogent) reason for not giving too much weight to this objection based upon quantity, it might be urged that an

exact equivalence between cause and effect does not seem to be always verified even in the physical world. Ostwald, the distinguished German chemist, has recently referred to certain substances that by their mere presence, without any discoverable loss on their part, assist other substances to produce a chemical reaction. For instance, if finely divided platinum be introduced among certain gases, the latter will combine much more rapidly than if the platinum were not there, and yet the platinum, although it has thus been effective in bringing about the combination of these other substances, is in exactly the same state after it has produced this effect as before.[1] In such instances as this the cause does not appear to have surrendered a certain quantity of its own being to have it reappear in equal amount in its result. No equation between them is possible. These and similar phenomena may force us, more and more, to the view that by cause we mean simply the total set of circumstances under which any event regularly occurs. Whatever is indispensable for the occurrence of any event we must number among its causes, whether the various items be of the same nature or not, or whether the quantum of one process alters in proportion to the event which issues from it. Under this view, which is at bottom the one which Hume long ago made us familiar with, there is nothing absurd in believing that mental events are, on occasion, to be numbered among the causes of physical acts, and *vice versa*.

Hume's view of cause.

[1] Ostwald, "Chemische Theorie der Willensfreiheit," *Verhandlungen der königlich-sächsischen Gesellschaft zu Leipzig*, Math.-Phys. Classe, Vol. XLVI, p. 334.

But to say that mind is a cause of physical events does not mean that an act of our body ever occurs solely by act of the mind and without suitable physical antecedents. Every one must admit that for many occurrences, like that of reflex action, the physical antecedents are everything. For other acts, like those of will, this doctrine of mental causation in the physical world would mean that, however many physical antecedents you may discover, — heredity, or disease, or habit, or physical excitements of the moment, — these do not fully explain the act. The mind, as well as the body, has contributed its share to form the total situation out of which the action springs. Consciousness might here be compared to the scene which impresses itself upon a photographic plate. The scene is not the sufficient cause of the photograph; it is an indispensable factor, and so must be numbered among the causes of the picture, but the picture depends also upon the light, depends upon the lens, upon the plate, and the chemicals employed in developing it. So, too, the inner act of will cannot be impressed upon the world by its own inner force alone; its peculiar efficiency requires the coöperation of the brain, the nerves, and the muscles, with all their intricate organization, history, and inheritance.

No bodily act without physiological antecedents.

Yet the mind at times contributes.

But there is a further objection to the possibility of an interaction of mind and body that must at least be touched upon. It is, that such interaction would be in conflict with the doctrine of the conservation of energy, an objection frequently urged at the present

Objection based on the conservation of energy.

time. It is at bottom very like the one we have just considered, — the objection from cause and effect, — and yet it differs in not appealing to some *a priori* conception of causality, but to certain generalizations of science based upon experiment. The thought here is, that if a mere mental desire or volition to raise my hand can start a brain-process which finally causes my hand to move, this would mean a production of energy in the brain without any compensating loss of physical energy elsewhere. The sum total of energy in the physical universe would thus be altered every time we willed to move our body, and the present belief that the amount of energy in the world is constant would be contradicted.

Interaction escapes this difficulty

Many answers have been given to this objection of which I shall select only one, given by the late Professor Solomons.[1] For every unit of energy appearing at some point in the brain as a result of our volition (he urged) there might well be a corresponding loss at some neighboring point. In other words, the fact that the will caused the brain-molecules to change their condition need not mean a change in the amount of energy in the brain or in the universe. The influence of the mind might be, not to add to the energy of the brain in any way, but simply to redispose it, to change the form of the energy already there, to determine which among various forms it should take, just as we might determine whether a given amount of energy in a piece of coal should take the form of light or of heat with-

[1] "The Alleged Proof of Parallelism from the Conservation of Energy," *Philosophical Review*, Vol. VIII, p. 146.

out our decision making any difference in the sum of energy involved.

The intercourse of mind and body consequently need not mean a give-and-take of physical energy, nor are we required, in accepting it, to give up the great principles of our present-day science.

and remains a live alternative.

Interaction therefore cannot as yet be ruled out of court and the decision be given to parallelism because it alone is left. Certainly either of them is at present a live alternative, with the future looking perhaps more favorable for interaction. But even in regard to this there are difficulties, in that we cannot understand how the interaction takes place. And yet, as Lotze has pointed out, any interaction whatever, even between physical things, is in the end a mystery. So that the difficulty in psycho-physical causation is not a special and peculiar one. One must also admit that it is perhaps premature to say just what will be the ultimate solution of the problem under discussion. We are still too much in the dark as to the details both of physiology and of psychology. If one has caution ingrained, and wishes to avoid even a provisional decision where the evidence is so far from being all in, it might therefore seem advisable to hold to some non-committal doctrine to be called, perhaps, "Correspondence," which includes only what practically all psychologists would accept. Such a doctrine would simply affirm an intimate connection between mental phenomena and the brain-cortex, so that occurrences on the two sides correspond, process for process, leaving it an open question what the more exact relation between the occurrences might be,

"Correspondence" for the cautious.

whether of interaction or of parallelism, or of something perhaps different from both. Most persons, however, would chafe at such restraint, and would prefer to push on, even at the risk of taking the wrong road.

Philosophy and the present question. And now a closing doubt as to whether in all this long discussion we have not, after all, been merely tilting at windmills, and, could we but clear up our philosophic vision, the whole question as to the relation of mind and body might not seem absurd. Could not those who believe that mind and matter are essentially one, — the monists, for instance, who hold that these two are but different appearances of some underlying reality; as well as the idealists who feel that matter is but a projection of the mind, — could not those who have this faith turn upon us and say that, from their philosophic point of view, the problem of parallelism or of interaction ceases to exist; that theirs is the true solution of the difficulty because it makes us see that mind and matter are essentially one?

The scientific problem *vs.* the metaphysical. It is doubtless true that the difficulty as to parallelism or interaction appears in a somewhat different light when viewed from the standpoint of philosophy. When mind is taken in its widest sense it is, so far as we know, all inclusive; there is nothing beyond, and there would consequently be nothing that could be either parallel or interactive with mind. In this idealistic view, psychic and physical phenomena are seen to be but two sets of occurrences within the larger compass of mind. But however satisfying such

an outcome may be to our philosophical instincts, I cannot feel that it really solves the problem with which natural science is engaged. Even if Professor Ward should be right in saying that the brain is but part of "experience as a result of intersubjective intercourse," while psychic phenomena are our personal and private experience, and that consequently all dualism between brain and psychic events disappears, yet the old problem reappears in a new form. The two kinds of "experience" are still distinct, and each has its separate occurrences, and we have still to decide what the natural-science relation between these different classes of events may be. The fact that they are both at bottom "experience," and therefore similar in kind and origin, does not decide whether the two orders of events, scientifically speaking, interact or run in independent courses. It is a simple question of fact to be settled in exactly the same way as it would be if we did not accept the idealistic view. Neither idealism nor any other metaphysical conception is, in itself, an answer to this question. As well might one claim that every query as to what has occurred between Briton and Boer was answered when once we were told that the two peoples were cousins by blood.

The really absorbing questions

But the psychological and natural-science problem which we have been considering is, after all, of far less vital interest than the further question of the relative worth and permanence of the mind. The questions that were asked of Socrates on that morning when he drank the hemlock, are the really

absorbing ones to which the experimental work is always leading us, but to which it can of itself give no answer. Is the body a mere garment which the soul may lay aside? Or is the mind like the harmony which comes from the lyre — something that must of necessity cease when the strings are loosed and broken?

are untouched by psycho-physiology.

The studies of this chapter are, as I have said, no answer to these deeper problems. The scientific results stop short of affirming the supremacy of spirit; but they also, quite as truly, stop short of asserting the primacy of nerves. The experimental evidence shows dependence and superiority on both sides. While it is true that drugs and disease can change the whole tenor of one's thoughts, it is also true that will and belief produce radical results in the physical world. The effects of hypnotism and suggestion as a means of healing illustrate this, not to speak of the purely material changes that have been brought about by the mental force of such men as Cæsar or Cromwell. We must not feel, then, that the experimental evidence favors exclusively the view that mental states are caused by the brain. Nor must we misinterpret the fact that, in organic evolution, intelligence may be regarded as a variation which assists the organism in its struggle for existence. The fact that the mind is useful to the body does not prove that this is its sole function. The carpenter is doubtless of service to his plane and saw; he sharpens them and keeps them in repair. So the mind may be of service to the body, and yet the body be but an instrument of the mind

Yet mind is not subordinate to matter.

— something to which the mind ministers, in order finally to reap benefits of a purely spiritual kind.

The extremists.

The practical outcome of all this seems to me to be a certain toleration and sanity in regard to both aspects of the world. In the first place, it leads one to be suspicious of theorizers who speak exclusively in physical terms. It has become almost fashionable to translate, not only psychological, but also educational matters into physiological phrases. Much is said nowadays of "central" processes; and the child's schooling is discussed as if its nerves alone were being treated. Social reforms are to be brought about by suitable foods and proper ventilation; while crime, as well as genius, is described as a kind of cerebral disease. Such one-sidedness cannot live long when once the facts are understood; but it is half true, and, for that reason, all the more difficult to dislodge.

Nerve-cell pedagogy.

The real importance of the body.

But we should be equally suspicious of those who are blind to the important place the body has in our life. We ought to strike some mean between those who see only the physical part, and those who disregard it. The material and sensuous world is not an enemy of the spirit; it is not the source of evil and sin, as the followers of Plato would maintain. Evil has its root in mind as deeply as in matter. Viewed aright, the body is the great opportunity for the mind; it is its means of expression; it must be depended upon in all cases where we act either for ourselves or for others. We must learn to respect it more, but to respect it only for what it can do for us in our higher aims. We must rid ourselves of the older

view that the body is a sign of finitude and defect, and regard it as a servant of our inner life. In the Heaven of Dante each spirit was manifest as a flame of fire. Each had its radiant body. It would not seem to me strange if, some day, there should be less hesitation in regarding embodiment as a universal mark of mind — that even the divine mind is like us in this respect. But quite apart from such a speculation, it is certain that we are formed after a divine pattern in this, at least, that there must be some utterance, or revelation of our acts in the outer world if our inner life itself is to be complete. The work of the physiologists in showing how each inner state has its appropriate and necessary expression in the physical world would thus be another support of Leibnitz's doctrine, that each of us is a repetition of the larger world in miniature.

CHAPTER XV

SPIRITUAL IMPLICATIONS OF THE EXPERIMENTAL WORK

The larger meaning of our psychological experiments is the special subject of this chapter. And yet to some extent this has been the topic of every chapter of the book. The distinct purpose has been, not alone to recount the particular experiments, with their apparatus and results, but to show if possible their bearing on life.

Laboratory experiments and the worth of the soul.

There remain some questions, however, that are connected with no special experiments, nor with particular results, but are rather suggested by the work as a whole, by the general experimental attitude toward the mind. This attitude has more than once aroused a doubt as to whether the mind is quite as worthy of respect after it has been subjected to machinery and computations. Does not the very fact that the mind submits to such treatment imply that it is on a lower plane, that it is grosser, than we may have once believed?

The propriety of inquiring as to the personal consequences of truth.

We are now to consider these broader consequences of the laboratory work: how it is affecting our belief in the reality and the worth of the soul. It seems entirely suitable to take account of such things and to ask ourselves what effect certain doctrines will

have on practice or on belief. There are those, however, who decry any questions of the kind. And certainly we should all feel that such questions were out of place when asked as an immediate *test* and before accepting scientific results. But some would go to the length of saying that, even after acceptance, no honest man would for a moment ask himself what were the personal consequences of a doctrine; his interest would be confined merely to whether it were true or false. This heroic devotion to truth, regardless of the effect the truth may have, would be more admirable, however, if it had not in it a touch of fanaticism. There are religious and moral fanatics; there are also scientific and intellectual fanatics — persons who are seized by this single, limited interest and see all things subordinated to it. For, after all, knowledge was made for man, and not man for knowledge; and those who feel that truth is something ineffably sacred, and that in its presence man and his interests are not to be considered, simply commit on a grand scale the old fallacy of the miser who ends by worshipping the gold which at first he valued only for what it would bring.

One may therefore be intellectually honest, willing to look the truth in the face, and yet be primarily interested in what the truth has in store for him and for those like him.

Are the experiments founded on doubtful metaphysics?

A friend of mine, a man of great philosophical acuteness, is doubtful of the psychological laboratory because he believes it to be founded on questionable metaphysics. He thinks that every one who experiments on mind, openly or tacitly commits himself to

the doctrine of parallelism,[1] and that if parallelism should be disproved, all this work would be undone. The more common impression, however, is that the experimenters here must of necessity be materialists; for there certainly is an air of materiality about any study whose chief engines of discovery are pendulums and chronoscopes. How can one hope to investigate the facts of mind with brass instruments unless he assumes that the facts of which he is in search are but a subtle form of material things.

The exacter methods commit one neither to materialism nor to parallelism.

But the conclusion in each case is entirely wrong. One commits himself neither to parallelism nor to materialism nor to any special theory of the relation of mind and matter by proceeding experimentally. Psychological experiments are but a special method of making observations, and there is no more metaphysics implied in them than in ordinary introspection or in the casual observation of a companion. If you were to conclude that your friend, on some occasion, was embarrassed because he blushed, no one would feel tempted to say that this inference of yours implied that you were a materialist or a parallelist. It is evident that your conclusion is not based on any particular theory of the connection of mind and body, but is drawn from the common observation that blushing and embarrassment often go together, and that you are reasonably safe in concluding that in this instance the one is a sign of the other. But, strangely enough, if instead of simply looking at his skin, you take a record by means of a plethysmograph, you are at once supposed to have surrendered to a metaphysical

[1] Cf. p. 278.

theory. The new method, however, is simply a refinement of observation, and the user of instruments of precision need have no different philosophy from one who only uses his eyes and his memory.

No more is implied than in ordinary observation.

Or, to take another illustration, we may observe that one person can learn in a few seconds what another cannot acquire in twice the period, — this without prejudice to the question of the ultimate nature of mind. But if instead of depending on my careless impression as to the time involved, I measure it by tuning-forks and smoked paper to a thousandth of a second, I am not thereby giving the work a materialistic or parallelistic or any other bias. The fact that the subject presses an electric key when his mental act — say, of arithmetic — is complete, hides no more dangerous implications than if he were to utter the answer by word of mouth. Nor is it assumed that in careful experiments of this kind, the printed number presented to his eye causes only physical processes, and that the mental action is "parallel" rather than a result of the brain-action. All these problems are left open, to be decided on their own merits by whatever means are best adapted to their solution. We do not have to *assume* some answer to them in beginning our experimental work.

With this brief consideration, therefore, I shall dismiss this first question by saying that our laboratory work does not require us to take for granted that mental phenomena are at bottom facts of matter, nor do we have to assume that mind and body are connected in some particular way. Questions like these are in exactly the same status, as far as bias is con-

cerned, as if we confined ourselves to simple observations of our own mental phenomena and those of others. The laboratory psychology makes no strange assumptions; it is not in some mysterious way a device of materialism, or of something equally dubious. It is simply a better way of doing what men have always done in the study of mind.

We may therefore pass on to the next question, as to the actual effect of such laboratory studies upon the belief in the existence of the soul.

"Psychology without a soul" is a just expression, to some extent.

The new psychology, with its physiological and laboratory methods, is often referred to as "psychology without a soul." Later we shall see that this expression is half untrue, but yet it does seem to me to be in some ways an excusable designation of the work; it really is, to some extent, "soulless," in the sense in which this word is applied, for example, to corporations: it goes on its way with but little heed to moral or religious considerations. All those ways of looking at things by which their personal value is taken into account are sedulously avoided. So that psychology is, indeed, a heartless, unemotional way of regarding even our most cherished spiritual affairs. Just as the physician may lose sight of the person, in his interest in the "case," so psychology deals with the facts of the mind in a cold, impersonal way; it is interested in *facts* rather than in duty or in human welfare.

The former office of the "ego."

But in a more technical sense the study might be called "psychology without a soul." As a friend of mine sat one day in his garden, a pedler, who had

evidently seen better days, passed in, and noticing that he was reading a book on psychology, asked whether the present-day writings of the kind had much to say about the "ego." My friend had to confess that the ego had fallen somewhat into neglect. In the older days of psychology, whenever there was an especial difficulty that had to be overcome, it was easy to appeal to the ego, or the soul. It was a *deus ex machina*, called in when the situation became particularly untoward. And, indeed, does it not seem a valid mode of explaining a mental occurrence, such as an act of will or the recollection of an event, to say that the mental process occurs because the self is there to produce it?

The nature of scientific explanation.

The great objection to introducing the self as a means of psychological explanation is, that the ego is not a particular mental process among other processes; it is not an event in experience, out of which other events may flow. The older attempts to employ it in scientific explanation were very much like accounting for the climate of California by saying that nature causes it. The statement may be true enough, but it is not enlightening. What we wish to know is, what particular features of nature bring such mildness of summer and winter; and if the Japan current can be shown to be responsible, the state of things becomes relatively intelligible. But nature is a collective system of occurrences, and to use it as a principle of explanation would be equivalent to saying that "the All" does some particular thing. We do not understand the special phenomenon any better after hearing such an utterance than

before; we are still in the dark as to the antecedents from which the facts in which we are interested spring.

The soul is scientifically useless here.

So it is in psychology. The reason why the specialists are often ready to accept the paradox that the soul may here be left out of account is simply because it is, scientifically speaking, of no immediate assistance in explaining mental events. The soul is not a particular mental phenomenon among other phenomena. It is, rather, the personal system within which my particular mental events occur. It bears the same relation to the particular facts of my mind that nature does to the events of the physical world. And just as the various sciences, while all the while concerned with nature and her ways and history, nevertheless, in a sense neglect her, in that they never refer to her as the cause or explanation of particular events; so our modern psychology is learning to proceed without the soul. Not that in a further study one finds no evidence of its existence, nor does in any true sense neglect it, nor ever can neglect it. Every new fact in the mental life, and every new context that is revealed, does in reality add to our knowledge of the soul. But the psychologist has rightly recognized that his work must be to seek for precise and particular causes in the mental realm, and never to rest satisfied with attributing the event broadly to the ego, or self. The current phrase, "psychology without a soul," simply means, then, that in the treatment of the mental world after the manner of natural science, the mind as a whole is not to be employed as an explanation of particular mental occur-

Yet a deeper study cannot neglect the soul.

rences; it is not a phenomenon among phenomena; in the limited, scientific sense of the word, it is not the cause of its own occurrences.

But if not a scientific cause, why believe in the soul?

But men are influenced by the phrases they employ, and the mere words in which this thought is clothed will probably encourage the notion that the soul is something in which the enlightened mind no longer feels called upon to believe. To say that in the more recent treatment of psychology there is no immediate use for any deeper reality than our desires and ideas, and that if the soul exists, it certainly is not a cause in the scientific sense, sounds not unlike the assertion that it is not a cause in any sense whatever. And this would be equivalent to saying that it does not exist. For no one will long believe in anything that is not causal and active. The sign of reality is that it can *do* something. When it ceases to be of influence, it ceases to be. So that it is important that we keep before us the fact that the soul, in spite of its disappearance from psychology, has not disappeared from the earth. It is, indeed, the most active thing with which we have any direct acquaintance. And our modern psychology, while waving farewell to the soul with one hand, is, in truth, earnestly beckoning it back with the other.

The modern view is not so soulless as the old associationism.

For, in the first place, students are beginning to be aware that the mind can never be treated in its fulness so long as we conceive of mental phenomena too closely after the analogy of physical events. From the time of Hume and Hartley, even down to the present day, there has been a school of

psychologists who believed that they could adequately describe the mental life somewhat after the manner of our present nebular hypothesis in astronomy. Just as the prominent celestial bodies are due to the aggregation of numberless particles of disseminated matter called star-dust, so the mind was conceived as beginning in a kind of scattered idea-dust — minute and chaotic psychic elements, or sensations — which gradually collected into more or less stable groups until there finally emerged, by further thickening and more complex groupings, an orderly system of experience with its ideas, its emotions, and its reasoned acts of will. This good old associationist view ought really to have been called psychology without a soul; for the most real things in the mental life, according to this conception, were the constituent elements, the primitive sensations, and whatever mind there was came from the assembling of these individual sensations. The soul was simply a collective term for the numberless minute impressions which came and went, no man could say whence or whither.

The older doctrine was hostile to our higher interests.

It is not difficult to appreciate what a chance affair the mind was, according to this view. The soul had no inherent power; it had no inherent stability; it was entirely a creature of circumstances. Morality was a matter of custom; immorality was not to be seriously considered.

Persons viewed as relatively unreal.

The essential features of such a doctrine, however, have not been confined to the psychologists. Much of our current popular thinking runs the same course. The influence of society upon the individual is often represented as if, surrounding us all, there were a

great stratum of impersonal thoughts, a mental atmosphere that had its own storms and sunshine. From this would be explained the common impulses, the passing styles of thought, the "movements" that pass like a wind over the minds of men. Those who believe in thought-transference often have a similar view; thoughts seem to them to be relatively separate and self-existent things that can literally pass from one mind to another. The mind is viewed as a kind of receptacle for thoughts, as in that classic figure where each of us is likened to an aviary, and our thoughts to imprisoned birds.[1] And just as the birds may escape from one man's enclosure to that of another, or perhaps fly about and be possessed by no one at all; so our thoughts are pictured as though capable of existing separate from the mind, and we as simply their temporary assembly. In Oriental philosophy there is a kindred belief. The individual is but a drop, separated, for the time, from the mother sea of impersonal life into which, in the end, he is to return. The common feature in all these conceptions, otherwise so different, is that the person is less enduring and important than the constituents that enter into him. He is but the artificial form which they assume. He is but a temporary group, or product, of psychic facts that can quite as well exist in an impersonal way.

Mental phenomena regarded as acts of persons.

One may truthfully report, I think, that this conception has for many years been losing ground among psychologists. The ascendant view, and the one that seems to me by far the more convincing, is that

[1] *Theætetus*, Steph., 197 *et seq.*

sensations and judgments and memories, and all things else in our mental life, are to be conceived, not as self-complete and relatively independent things, but as acts of a living being. The analogy of particles of matter grouping themselves into objects cannot be made to apply to mental processes. The changes in the moral world are not a mere reshuffling of older entities. The mind can no more be constructed out of small pieces of ideas than the living body can be conceived as resulting from a gradual assembling of scattered heart-beats, with, later, a stray digestion and the rest. The relative standing of the soul and its sense-impressions is thus entirely reversed. The mind is the deeper and more permanent reality, and mental phenomena are its ways of behavior. It has power and activity from within. It is not a mere creature of circumstances, — not a mere eddy in the endless stream of sensations, — it is an agent, a person, facing the world, and acting upon it with will and intelligence. In offering this conception that the mind is an active participant in the world of events, now conquering and now for a moment beaten back, but all the while a power as real as aught we know — in presenting such a view modern psychology is by no means justly to be called psychology without a soul. Nor is it to be called soulless because it does not speak of some spiritual reality separate and aloof from our common life of mind — from our plans and disappointments, our daily joys and pains. It is often popularly thought that the soul is separate from the mind; that it is a substance in which are lodged the

The soul is not a product of sense-impressions.

Higher and lower processes are intimately joined.

more dignified attributes of the spirit; its conscience, for instance, and its ideals — what we sometimes call our spiritual nature. But there is really no reason to disjoin the higher and lower life in this way. We do not need a soul separate from our everyday mind, any more than we need two bodies, — one reserved for the state occasions of life. Conscience and ideals must be willing to come close to homely things, must live in touch with our commonest acts, or they may as well be wanting. So that in making no separation of the soul from our most familiar processes, psychology will do the spiritual life no harm.

Persons are the elemental facts.

I feel, then, that as far as the reality of the soul is concerned, the new psychology is in advance of the old. It makes the mind a living, a personal, thing. Every thought that arises, every emotion that stirs, is significant only as part of the larger life of a personal being. Persons are the elements of reality; they are not products, nor drift. The mind is not a mechanical interplay of psychic atoms; it is a living whole.

But persons are subject to psychological laws.

Some may feel, however, that while modern psychology is thus recognizing the reality of the person, it is to some degree undoing this good work by reducing the behavior of the person, as far as possible, to law. The old notion of the "uniformity of nature," which has been so helpful in investigating physical things, is now quite generally extended so as to apply to the mental realm as well. The uniformity of mind, in the sense that like circumstances lead to like results, has now become the general

principle upon which the experimental work in psychology is based. And this uniformity of mind is not just taken for granted and there left, but it is, as time goes on, receiving considerable verification. The preceding chapters have attempted to describe certain discovered regularities of this kind which seem to be quite as constant modes of mental action as are the laws of the physical world. Thus you may recall the simple instance that all persons note the difference between things more readily when the facts are brought to the mind in succession than when occurring at the same time; or that the mind is universally subject to illusions, due to certain habits of interpreting our impressions of sense. These are laws of mental operation, and our study of mind is steadily enlarging the area within which such uniformity of action is observed. The more we become acquainted with ourselves, the more of these machine-like regularities we discover; until the thought is forced upon us that this constancy of behavior under like conditions is an absolutely universal feature of mind, and that where we fail to find it we must simply conclude, not that it does not there exist, but that our eyes have not yet become sharp enough to detect it. We must therefore ask ourselves whether regularity of this kind in our mental actions does not make personality a less noble thing, and especially whether it does not endanger our belief in human freedom and responsibility.

Experimental evidence for this.

Does not this mechanical regularity detract from human worth?

To many persons, and perhaps to all of us in certain moods, a view like this where uniformity reigns is cheerless enough. Life seems to have been robbed

of some of its interest. There is nothing in store that is not somehow prefigured in our present mental states. A touch of unromantic calculability underneath all seems to take from our spiritual dignity and to make us appear to play a puppet's part in life.

The value of life does not depend upon novelty.

And yet I cannot feel that the thought of pervasive regularity should in itself detract from the charm or value of life. One may lay too much stress on the element of surprise. It is undoubtedly true that we are quickened by meeting the unforeseen; but our attention and interest is not wholly dependent upon such stimulants. Home-coming, or the intercourse with old friends, is attractive out of all proportion to the novelties we discover. The preference of children for an oft-repeated tale reveals the same trait. They are so familiar with its course that they mark the slightest departure from the original form, and yet they will have the old story rather than one where much is new. And certainly our serious moral interests are even more firmly based on other things than novelty. The affection which the mother bears her child does not require the intellectual spur of the unexpected; it may persist even in a heightened degree where the child has met some check in its mental growth, and where all hope of change has finally died away. Or if the child develops in the sound way in which the mother expects he will, this does not hinder her attachment. Those who pity God because, as they suppose, he sees the end from the beginning, do not understand the psychological foundations of interest and love.

The ennui, therefore, with which some anticipate

a life unfolding according to law, is but a feeling of the idle hour. The train of events looks tiresome because we assume toward it, for the time, something of the novel-reader's attitude. But in actually living it we drop this fine intellectual or æsthetic air, and it becomes more and more a matter of moral relations, a matter of loyalty, of responsibility, of personal affection.

Yet surprises enough are in store.

The fear that the progress of life according to strict rule would steal its charm is groundless, moreover, not alone because, as I have tried to show, the interest in living does not depend on sudden and unexpected turns, but because in the very nature of things surprises are sure to come. The natural law of the mental life is, after all, a thing infinitely complex. Even if our knowledge of it were many times extended, the feeling that regularity makes life dull and tame would be like the notion that one's interest in the human face would of necessity cease because he had discovered the way in which our features are always arranged. Back of the simple scheme of two eyes, a nose, and a mouth, are the endless specific modes in which this formula may be fulfilled. No two faces alike, and yet all modelled on the same plan.

Higher stages always bring the unexpected.

But not only will the fulness of the mental life never be exhausted by our rules, since the ways in which the simplest scheme or law may be embodied are endless, but the nature of mental growth is such that we have no way of telling what many of its laws will be until the slow progress of events brings them actually into effect. Most of our natural laws, as

well as our psychological laws, are not, for us at least, like Platonic ideas, existent in perfection from all eternity. They are what has been termed "contingent truths"; they are simply our way of describing our life as the life itself unfolds. And this growth is always taking new directions, revealing new features that could never have been anticipated from our knowledge of the formulas that sufficed for the earlier stage. The laws that are sufficient to describe, for instance, the behavior of fire and air and water before there was life upon the earth, give no hint, so far as we can see, of the wonders of vegetation. And probably we might fully formulate the changes of plants without their laws implying that consciousness would ultimately appear upon the scene. When these higher stages are reached, we see that they rest upon the lower, that there is no absolute disconnection. And yet, along with the continuity, there is something entirely new. After the event, we can see that the conditions for its coming have been in long preparation, but we could never have assuredly foretold its coming from a natural-science knowledge of the antecedent facts. The preceding events are apparently necessary for its coming, but they do not *produce* it; it is, after all, in some respects a gratuity, an act of supererogation, of the universe.

Illustrations in the psychic field.

The inner development of the mind itself shows similar stadia of growth, similar incomings of higher functions, which the simpler forms of mental life had given us no reason to expect. The feeling of musical harmony might serve as an illustration of what I mean. The pleasure we take in certain musical

chords is more than the mere perception of the sounds that enter into the chord; it is even more than the power of comparing the impressions and of appreciating that they are of different pitch; it is more, too, than the sum of the pleasures we get from individual notes. It is an absolutely unique experience, a unique mode of appreciating the tones, which, so far as we can now see, the mind might have lacked through all eternity, and no one could justly have said that the earlier life had given promise of something which the later facts had failed to fulfill. Of a similar nature is memory — the conscious survey of the past, — as well as the pleasure of imagination. They slowly and silently appear in the history of the race; they are built, in the closest way, upon the earlier mental foundation, but they are not necessarily implied in its earliest form. Out of the depths of the mind, new powers are thus always emerging. Until they are awakened, neither apparatus nor scrutiny will show that they are there. When we understand our life more fully, therefore, we find no ground for supposing that the laws of the present, or even of any future time, will take the interest from what is still to come. There seems always to be something held in reserve, and no amount of science can ever take from the world the element of wonder. It never will become as a tale that is told.

Psychological laws are not external forces.

But if the constant presence of law still seem in some way a menace to our power and responsibility, we must remember that laws are not forces externally compelling us to behave contrary to our own nature; they are mere descriptions, mere statements, of how

the mind actually does behave. Definite character always presupposes some specific mode, or law, of behavior. Indeed it would be difficult to conceive of a personal existence of any kind that would be lawless, in the scientific sense. If, then, we were to suppose free beings to exist, we should naturally expect them to reveal some inner law. We should expect them to have a definite nature, to show constancy and system, and to act with reference to what was present and what had gone before. When, therefore, our observation of ourselves actually brings out what these definite forms of action are, we certainly cannot use these discoveries as evidence against the reality of freedom, with which, in truth, they so well accord. Here as elsewhere, therefore, law and liberty are compatible and even inseparable. At first the effect of psychology is to encourage the notion that everything is mechanical, and that no place is left for personal force and will. The very regularity of nature revives the belief in fate. Further insight, however, shows that we do not have to choose between persons and law, but that personality itself is the most perfect example of law.

They are compatible with human freedom.

Are these laws subject to amendment?

Our instinctive distrust of law, however, does not spring wholly from its long association in our minds with the impersonal powers of nature, with forces that have no regard for the sufferings and desires of men. In part, at least, it may arise from our experience with human governments. No political constitution has ever been devised broad and elastic enough to suit forever the character of a changing people. There comes a time when a violent disruption alone

can bring the constitution into accord with the nation's new life. But when we turn from political government to the constitution of the world of things physical and mental, it seems as if this larger order of things were neither subject to amendment nor capable of change by revolution. The whole seems fixed beyond our utmost power. So that we perhaps unconsciously feel that rigidity like this can never give lasting satisfaction to a living and growing mind.

Indications of such a possibility.

But, as I have tried to show, this fixity can easily be overstated as regards the inner constitution of the mind. Its laws are, to some extent, like those of a healthy state, subject to new enactments as new situations arise. And probably beyond the limits of our present knowledge there are conditions that are even better adapted to our growth. May it not be that death itself is just such a period of adjustment, when there come into effect new laws, both inner and outer, that are better suited to the altered wants of the person. Looked at from every side, it seems clear that natural law need never be found to be a check upon our growth. Especially as it is revealed in psychology, it is the sign and evidence of the deeper life within.

The general bearing of psychology.

This is the bearing of recent psychology, it seems to me, on the reality and worth of the soul. These great doctrines are certainly in no real danger from the modern scientific treatment of mind. Indirectly, the work ought to strengthen our confidence in spiritual things. It is, itself, a sign of a growing interest in the mind, and will react and stimulate the

interest from which it springs. It is already assisting us to recover from that almost exclusive attention that has been given for so many years to the parts of nature that are below the human plane. And in the end it will be clear that man can never be understood until he is regarded not simply as a physical fact, nor merely as a group of psychological phenomena, but as a centre and source of activities — as an underlying reality — of which the special occurrences with which our laboratory experiments are busied are but surface and outcrop.

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The following abbreviations are used: exp., exps. for experiment-al, experiments; phen. for phenomenon, phenomena; psych. for psychology, psychological-ly. Other abbreviations are self-explanatory.

WORKS BY

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